Engineering News-Record

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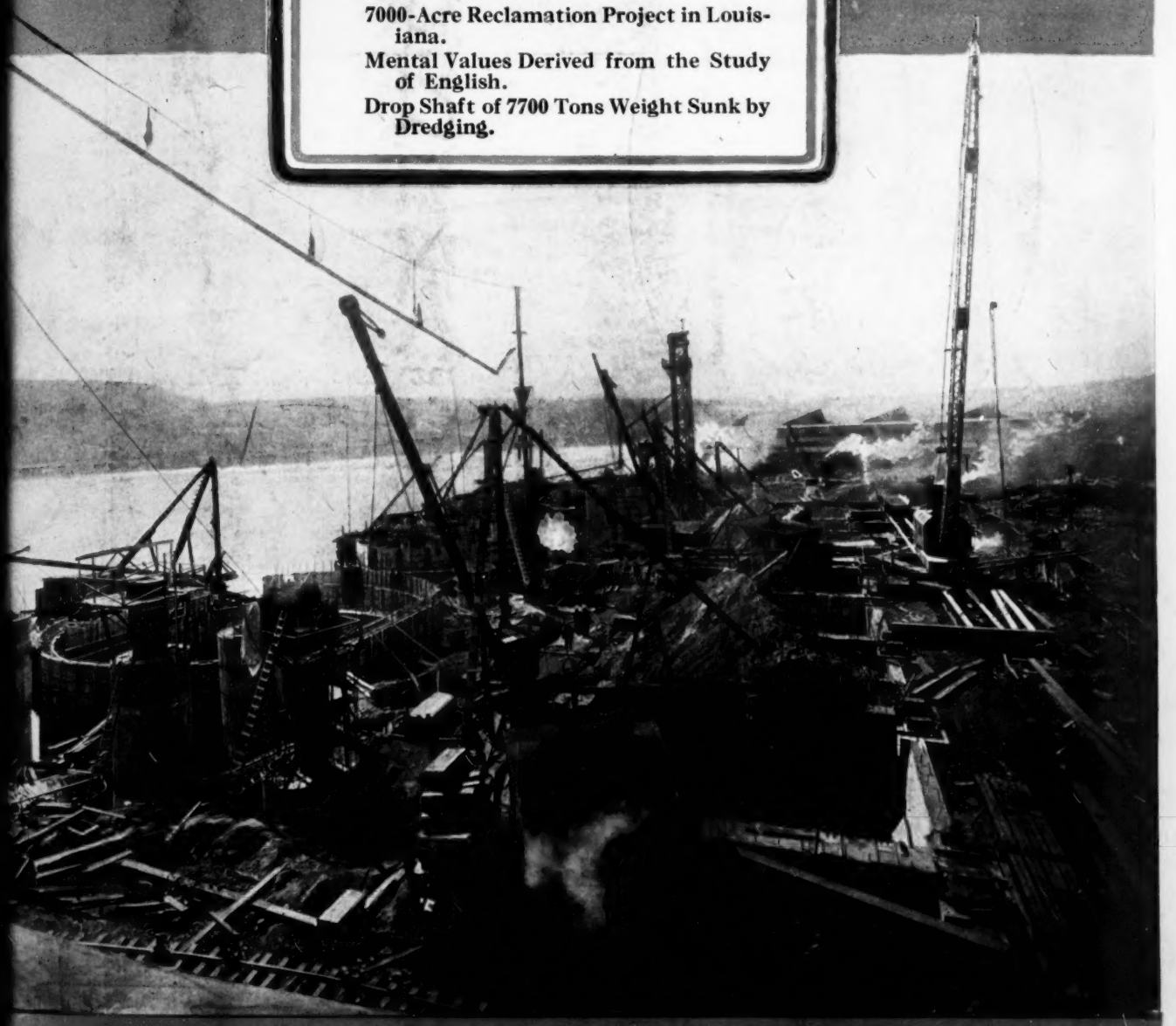
7000-Acre Reclamation Project in Louisiana.
Mental Values Derived from the Study of English.
Drop Shaft of 7700 Tons Weight Sunk by Dredging.



Foundation Work for Large Cincinnati Power Station, Requiring 50,000 Yards of Concrete, Finished within a Year.

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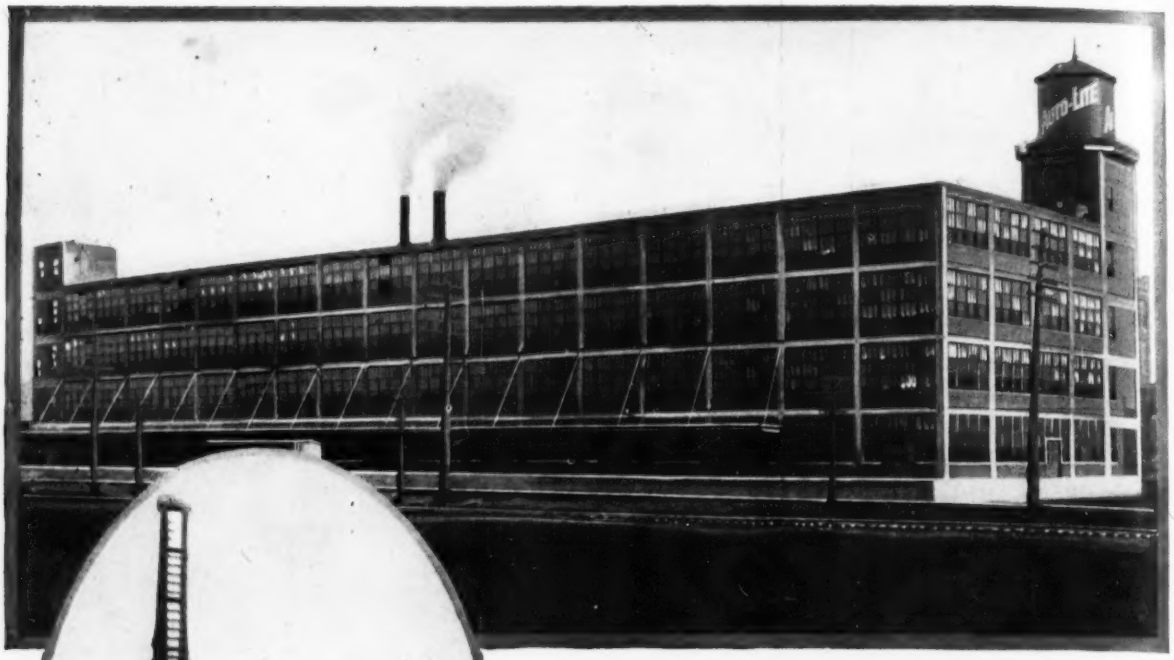

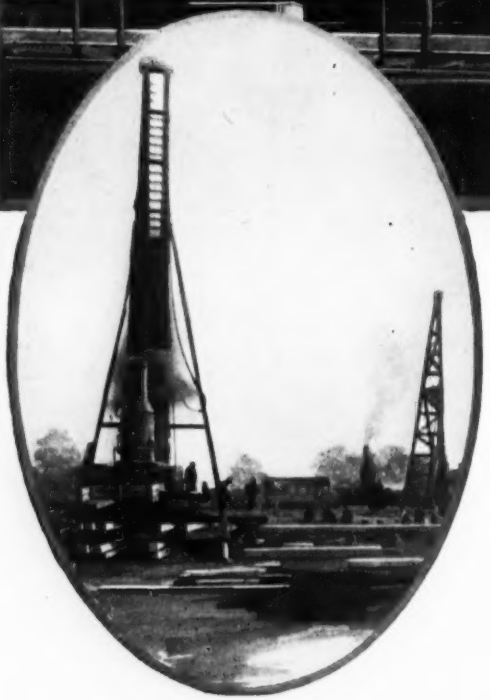

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Why has the Second Largest Automobile Company in the World Used 350,000 Feet of

PEDESTAL PILES

This photograph shows the new factory building of The Electric Autolite Co., Toledo, Ohio—a subsidiary of The Willys Overland Co.

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Under all the buildings of the Willys Overland Co. are about 350,000 feet of Pedestal Piles!

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ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
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AND CONTRACTING

Volume 79 NEW YORK, THURSDAY, SEPTEMBER 27, 1917 Number 13

The Pledge of Business

LAST WEEK the business men of the nation, under the auspices of the National Chamber of Commerce, met in war convention in Atlantic City. Without reservation they pledged their support to the Government in the present crisis. The pledge really was not necessary. Already there is ample evidence of the whole-heartedness of the support of industry. Yet if there were doubting Thomases they should be convinced by the size and quality and earnestness of the gathering at Atlantic City. The nation is at war. So is business. Its first thought is for the Government. The nation's leaders need only say what they want. The business men of the nation will promptly respond.

Professor Crandall— A Successful Teacher

THE LOT of the professor of engineering is not always a happy one. Compensation is low, recognition is often belated. The main reward must come from a sense of duty well performed and the affection of a long line of students. Success of the more material sort came to Professor Crandall of Cornell University, whose death was noted in last week's issue, but the crowning professional success, the affectionate regard of forty engineering classes, was his in exceptional measure. Kindliness and sympathy were the lodestones by which he attracted the young men, and forever kept them as friends; but to these traits he added a sureness of technical knowledge that made him in after years a professional mentor as well. His work and the place he holds in the memory of his boys should be an inspiration to every teacher. He showed how great a success can be made in the teaching profession.

Coercion by the Government

RELIABLE information has come to *Engineering News-Record* that attempts have been made by a district office of the Division of Valuation, Interstate Commerce Commission, to induce the railroads not to hire away at larger salaries the division's men. The plaint of the district office is that while the railroads can take on men at once, whenever found, it requires from two weeks to a month for the division to secure men through the Civil Service Commission. The argument is addressed to the railroads, but it is the individual men who suffer. Our informant suggests the contrast between one arm of the government kneeling a year ago to the strongly organized trainmen, and another arm trying through private correspondence to "restrain a group of underpaid technical men who have no union, but who claim the right to an open market for their services." Should they be denied that market because of defects in the government's way of securing employees? *Engineering News-Record* is glad to have learned from the director of the Division of Valuation that he knows of no such attempt at coercion, and that he has, in fact, "stated to at least one railroad that it was perfectly free to offer employment to any of our men." But there are many railroads, and it is to be hoped that he will pass the word down the line that such coercion is not to be countenanced.

Guarding City Money Supplied to Promoters

HOW far a city should go in providing funds to experiment with new proprietary processes is a question that sometimes confronts municipal engineers but is more often settled by city councils or other administrative officials who lack technical knowledge. One thing is certain: Where funds are provided by a city to test some untried process the city should be protected by adequate contract guarantees and surety bonds. An unusually well considered contract of this kind was recently drawn by the Board of Public Service of St. Louis, Mo., at the request of the City Council, as outlined on page 535 of the *Engineering News-Record* of Sept. 20, 1917. This contract was designed to safeguard the city against the possible loss of $17,000 which it agreed to furnish for the installation and test of a system of garbage reduction which the promoter claimed would cost far less to install than one recommended by the Board of Public Service. The board, which drafts contract ordinances for enactment by the City Council and is composed largely of engineers, wrote a contract which states just what the claims of the promoter are and how a decision as to their fulfillment shall be reached, and exacts a bond to insure the return of its money to the city in case the claims are not met. The contract may well serve as a model for other cities whose authorities set aside the recommendations of engineers while testing the claims of promoters.

Right Kind of Economy

NO CONSTRUCTION work, especially in these days, should be carried out without careful study. We need more of the sort of planning illustrated so strikingly in the description on page 593 of the methods used in building the huge power house at Cincinnati. Taking an existing coal plant, some ordinary spouting equip-

ment and a guy derrick arranged to revolve with a section of the chute line, the builders put them together into a labor and time-saving concrete plant on the efficiency of which it would be hard to improve. The plant was doubly valuable as the economy of the entire work depended on ability to place concrete quickly in large volume and, successively, at a number of scattered locations. In foundation work of this type everything waits on the concrete. If the mixing plant breaks down, the other operations are interrupted. If it fails to deliver the expected quantity of concrete at the right time, the entire work is delayed. The efficient layout on this work probably paid bigger returns in keeping the rest of the job going at top speed than the actual saving of labor and time in concreting. There is now such a heavy premium on time and labor that badly-needed construction work will be postponed unless both are economized to the utmost. Contractors who will think through every job as this one was thought through—it was as well-planned in other respects as in relation to the concrete plant—will be doing a big service. Not only is it a duty in the present time of stress for every contractor to give the most efficient service possible, but such service is bound to produce greater returns than in normal times.

Let All Back Government in Steel Price Experiment

THE RIGHT start toward solving the problem of fixing steel prices has been made, if first press reports of the voluntary agreement reached Monday last by the War Industries Board and the steel manufacturers are accurate.

This journal has maintained that prices of everything entering into steel products should be regulated if a low figure for the finished steel is to be set, and that unless this were done, and unless a price were named which would hold for the public as well as the Government, the results would be disastrous. The sort of halfway price fixing, to a taste of which we were treated by the Navy Department and the old shipping board, has been abandoned by the Administration, and the only method that could possibly succeed has been adopted in its place. The price of coke, iron ore and labor, as well as that of pig iron, billets and more finished products, is regulated by the agreement. These prices are the same for the Government, our allies and the public.

Buying competition is eliminated by the operation of a priority board. The relative urgency of requirements is determined by this board, and not by the amount of money a buyer is willing to pay for quick delivery. If there is enough to go around, everyone will be supplied in turn. If not, those who want steel for purposes least essential to the war will have to wait, however much they could afford to pay for it.

In short, the plans for suspending the operation of economic laws are complete. Whether they will succeed is still open to doubt. It is said that England has failed to fix maximum prices in any instance. If this country fails, however, it will not now be for lack of intelligent leadership, nor for lack of patriotism. It will be because the problem is too complicated to solve in the short time available. Suppose, for instance, it should be found impossible to hold labor in the steel mills at present wages. This is a remote contingency, perhaps, in view of the fact that the steel industry has so far led the rise in wages. But suppose that the rise, now checked in the steel industry, continues in other war industries until steel-plant wages are forced to follow. Present maximum prices would undoubtedly have to be adjusted again. Numerous other upsets of this sort may be in store for the present price agreement. However, the Administration has recognized these difficulties, and a readjustment, if such proves necessary, will be made Jan. 1 next.

Whether the task will prove so complicated by then that it will be abandoned, no one can say. We may succeed where others have given up. In any event, it is the duty of those in the construction field, as consumers of steel products, to back the Government with a will. All essential projects will be taken care of, and those who have planned work which is not needed for the war must cheerfully forego for a while future benefits which might be derived from its immediate execution. Although existing contracts are protected by the price agreement, it would be a fine thing if engineers, owners and steel mills could get together and submit to the priority board all existing contracts for steel to be used in construction work where it is possible to substitute other material or to postpone the project without crippling those involved. The most important use for every one of us to which steel can be put is Government use. Let all help the Government to secure the steel it needs on time!

Highway Relief for Railroad Congestion

FOR YEARS the inability of the railroads to handle the business consigned to Atlantic ports has been patent. Embargoes have been chronic. To relieve this situation, and in general to prevent waste in transportation, the Railroads' War Board was established shortly after we entered the war. The results have been excellent, and the hope is entertained that through its efforts we shall be able to handle successfully the tremendous volume of freight that is coming.

But we have not yet experienced peak conditions. The millions of dollars' worth of supplies ordered by our Government for use abroad have not yet started to move to the seaboard, and our allies are continuing their purchasing. When the factories begin to ship, the carriers will be deluged with freight. Unless the railroad board's efforts prove successful, we shall see congestion the like of which has never been experienced.

In this situation it is the part of wisdom to take stock of all of our transportation resources in order that we may know what alternative facilities are available, how they may be used in case of emergency, and what steps are necessary now to put them in condition for maximum use if the demand should come.

Obviously, the waterways and the highways are two remaining agencies of transportation available. Already a subcommittee of the Council of National Defense is working on the waterway problem. To some extent, also, this committee is looking into the use of highways—particularly as they serve as feeders to the waterway system. The highway problem, however, is so large that it requires special study, and that from the standpoint of an emergency war measure.

Readers of this paper already know that the highways have ben called upon to a large extent to save industries crippled by the rail congestion. Many a factory and business house in Cleveland would have shut down this summer, or have been run on part time, had it not been for the fleet of motor trucks that have poured over the roads from Akron, Elyria and other points. A number of Michigan automobile plants have been making deliveries of pleasure cars and motor trucks this year via the highways from Michigan points to Toledo, Chicago and Indianapolis. One such plant has kept nine men busy piloting new cars from its factory to the seaboard. Furniture haulage between Boston and New York and between Philadelphia and New York is common practice, while the Goodyear Tire & Rubber Company will shortly increase a fleet of four trucks which has been running for a year between Akron, Ohio, and Boston. These trucks carry two drivers, and run night and day on a schedule that has been carefully worked out.

These are but a few instances in which the roads have saved the day for business which found it impossible to secure adequate service from the railways. They are sufficient, nevertheless, to show what can be expected from a comprehensive highway system. To what further extent, however, this highway system will be called upon for relief service, what coördination there must be between state and government to secure satisfactory pavements over long routes, what provisions there are now for maintaining these prospective relief roads, and what further maintenance methods will be needed should they be used by great fleets of heavy, fast moving trucks, are problems that need a most thorough study. It is safe to say that only here and there are there good interstate roads available, and that on these maintenance provisions are not equal to the strains that heavy truck traffic might put upon them.

In this situation there is imperative demand for a thorough study of the highway situation. It may lead to the conclusion that a Federal highway board is needed —comparable to the Railroads' War Board—to place our highways in a position to be operated at maximum efficiency as a relief for railroad congestion. The Chamber of Commerce of the United States, meeting in Atlantic City last week, recognized the seriousness of the highway problem, pointing out that all transportation agencies need to be brought to the highest state of efficiency in order that foodstuffs may be moved economically from farm to market, and manufactured products from factory to consumer.

If one further word is needed to point the urgency of the situation, one needs only recall that upon our entrance into the war various agencies were discouraging a continuance of highway building. Now we are awake to the situation. We know that foodstuffs that should go to Europe may rot on the farm for lack of adequate transportation, and that our fighting strength overseas may be seriously affected because of the difficulty of getting munitions from the inland factories to the seaboard.

Under these conditions action is necessary, and the first step, so far as highways are concerned, is the provision, through the Office of Public Roads or otherwise, for an immediate and careful survey of the situation.

Quebec—The Final Chapter

IN THE engineering world the name Quebec has for half a generation been associated with a great prospective engineering triumph. Twice the hopes of success have been dashed, but never in the heart of the true engineer was there doubt that the enterprise would be brought to a successful completion.

Now the great hopes are realized. The greatest of cantilevers stands closed across the St. Lawrence.

Just ten years ago the south half of the first bridge crumpled under its own weight, dragging a hundred men to their death. The investigations and discussions that followed destroyed that first project to its very roots. But new leaders were found, new ideas developed. On the wreckage of the old there arose the finest creation of bridge-building that any generation has seen.

What courage was required to attack the work anew can be realized only when one recalls the extent of the defects revealed in the old design. True, these discoveries were warnings for the succeeding designers, but impressed with the terribleness of the first experience their work could not but be haunted by visions of what had happened in that dark August of 1907. The new structure from the start gave evidence of the masterly hands responsible for it. A new truss design was developed, the shopwork was of marvelous precision and finish, the erection novel and courageous.

Yet, despite the most careful study and precautions, a second accident marred the record of the structure, when last year the suspended span, while being hoisted, fell into the river. One might think that in the face of this second discouragement the engineers and contractors responsible might have wavered in their determination to proceed. But he who thought so failed to reckon with the mettle of the men in charge. The wires had not finished sending the story of the lost span to the world when announcement was made that it would be rebuilt and erected by the very method employed last year. The promise of that announcement has now been fulfilled. What changes there have been from the previous erection plan are only in details. They are described elsewhere in this issue.

Before closing the final chapter in the design and erection of this remarkable structure, it is proper to record the debt that bridge-builders owe to the work at Quebec. It has advanced greatly our knowledge of the problems of large compression members and of tension bars. The effects of distortion in trusses were explored farther than before and means devised for dealing with such effects. Much knowledge has been added to our store of experience on the assembly of heavy members, while new standards were set as to degree of precision and finish in shopwork. Then there is, beyond all this, a great gain in our general grasp of the problem of very large bridges as to practicability and cost.

But these are the gains of the profession as a whole. To the individual engineer the great value of the achievement lies in the inspiration emanating from the courage of the men who have erected on the failure of 1907 and the loss of 1916 this greatest of bridges—and in so doing not only have erected a monument to themselves and their courage and ability, but have vindicated the profession before a doubting world.

QUEBEC SUSPENDED SPAN HAD TO BE LIFTED 150 FEET AFTER IT HUNG CLEAR

Quebec Suspended Span Successfully Hung from Cantilevers

Fifty-Four-Hundred-Ton Structure Floated 3½ Miles on Scows and Hoisted 150 Feet by Hydraulic Jacks and Lifting Links—Work Done Entirely During Daylight Hours

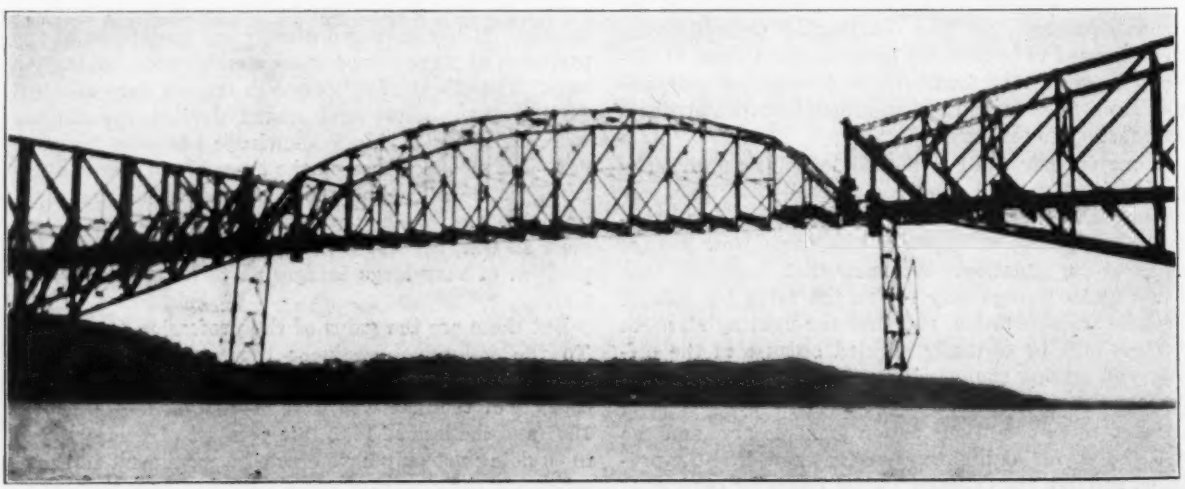
By HARRY BARKER
Associate Editor, "Engineering News-Record"

A NEW MILESTONE in bridge erection was passed last week when at Quebec the greatest single fabricated part of a structure was placed in position, the heaviest span ever floated was moved 3½ miles and the greatest job of jacking, both in total load and total lift, was completed. The complete success of every detail of the floating, hoisting and pinning, the remarkable adherence to schedules and the accurate checking of the engineers' computations of deflections and clearances throughout were the final answer of the St. Lawrence Bridge Co. and the Government board of engineers to critics of the design of the Quebec bridge and of the boldness of the scheme of placing the center span. Success has vindicated the judgment of the designers whose confidence was unshaken by last year's failure.

The entire operation was peculiarly dramatic to all the engineers who were fortunate enough to see it. The first day of the floating and connecting to the hoisting chains, and the last day when the final lifts were taken and the big pins slipped through the eyes of the permanent hangers, were filled with inherently spectacular moves. Even the two days of steady jacking were hours of constant interest in the ease with which the apparatus worked and the changing perspective in which the huge span was seen as it slowly rose above the river.

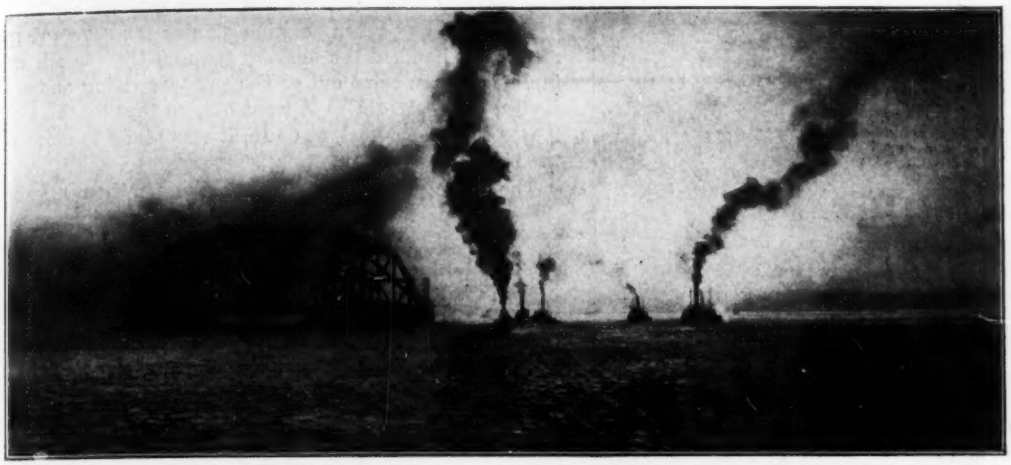
With each step of progress the confidence of workers on the bridge and watchers on shore grew firmer and firmer and at the end of the third day's work, when the plank platforms on the spans could easily be reached from the cantilever working floor, there was an eager rush of all the men to be in the first group to go across.

The faith of the men in the ultimate success of the enterprise was notably increased by the unique interest and confidence of the Sillery parish priest—Father Mc-

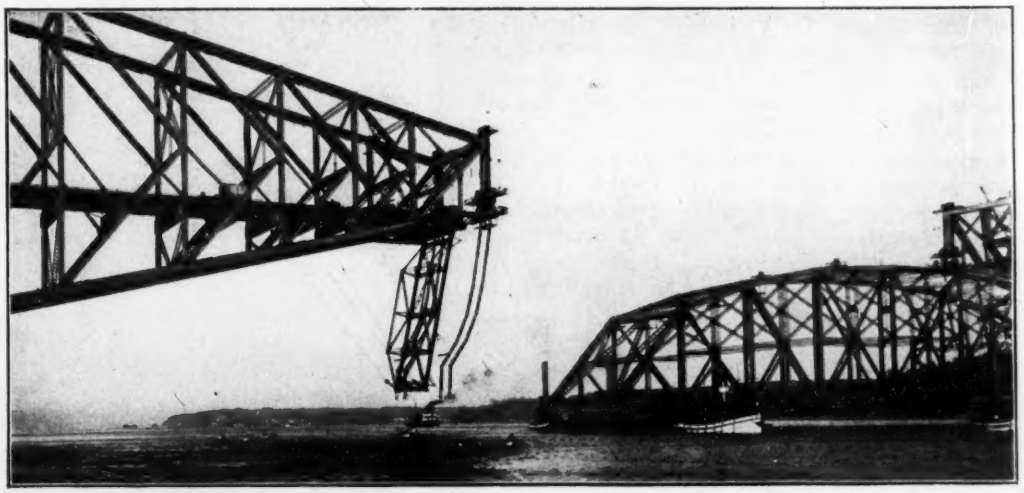


THE SPAN REACHED ITS FINAL POSITION AFTER FOUR DAYS' WORK

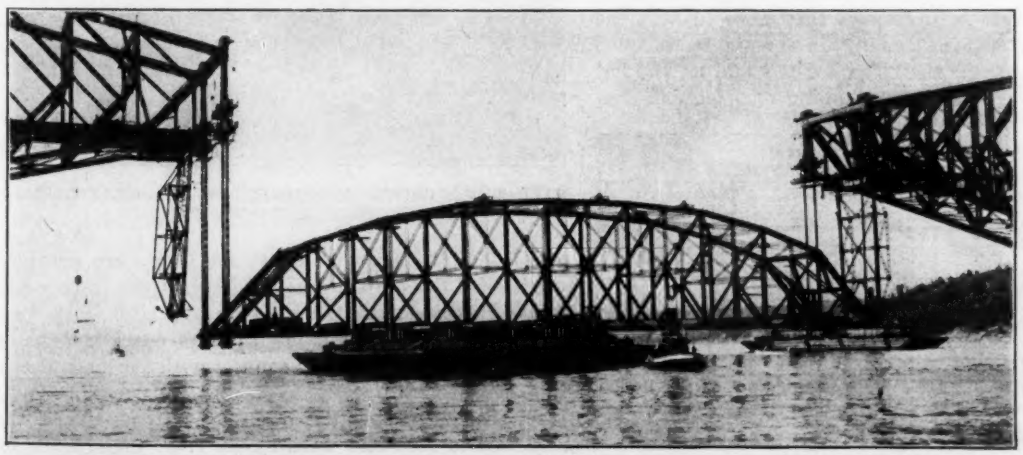
Three Preliminary Stages in the Raising of the 640-Foot Suspended Span of the Quebec Bridge Last Week



AT SUNRISE THE SPAN WAS TOWED OUT FROM SILLERY COVE

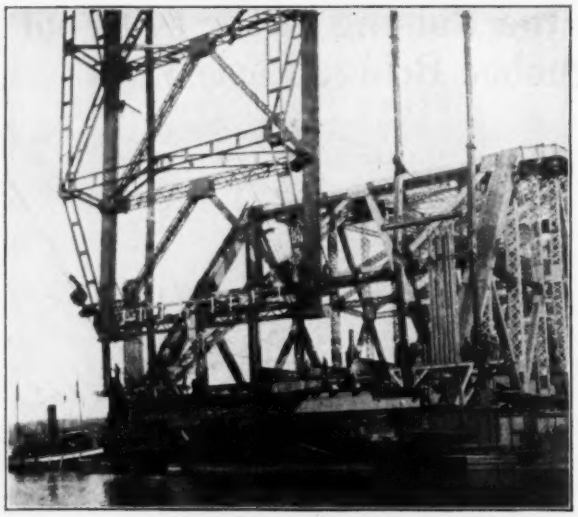


AS THE SPAN CAME CLOSE UNDER THE CANTILEVERS, GUIDE LINES WERE CARRIED OVER TO MOORING TRUSSES



Photographs by E. M. Finn, Staff Photographer, St. Lawrence Bridge Company

WHEN THE SUSPENDED SPAN WAS LIFTED FROM THE SCOWS THE CURRENT SWEPT THEM FROM UNDERNEATH



CONNECTING THE FLOATING SPAN TO THE LIFTING LINKS

Guire. A new force making for success was injected into the work and a new element was added to already dramatic scenes. On Father McGuire's initiative, the span and both cantilevers were blessed with due ceremony some days before the floating, and on the Sunday morning before the start a special Mass was offered. When the span floated past the Sillery church, all its bells rang out. Then the priest came out in a launch, boarded the span and rode up the river with it. He was around the work thereafter and spent the whole of the last day on the end platform of the north cantilever.

It was first intended to float the span Saturday, Sept. 15, but high winds Friday night and reports of an approaching gale led to postponement of the work for a day; then as the workmen were rather desirous of not working on Sunday, the start was put over one day more. With Sunday and Monday came perfect weather and good prospects for Tuesday and Wednesday, and the undertaking was started. The delay was not without benefit, for the smoothness of the operations on the succeeding days was due in no small measure to the practice drills with the jacks and pins.

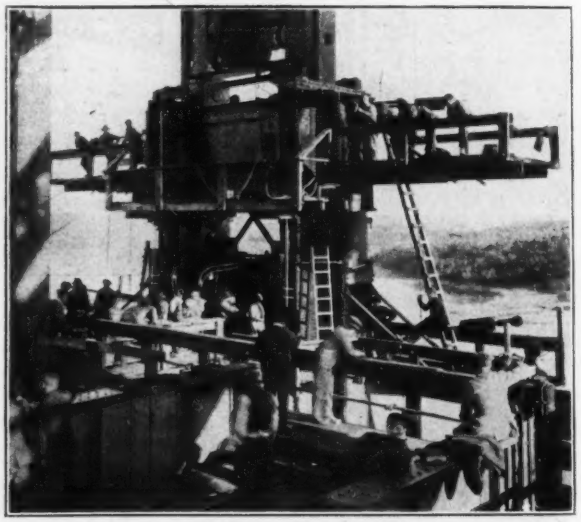
As the tide reached low ebb Sunday night, men closed the bottom valves in the scows that were to float the span. The water rose steadily on the six scows until they lifted gently off their foundations and let the flat bearings, employed for the swinging on fixed end supports, come free. This was approximately at 5: 15, and by 5: 22 the lifting girders were perceptibly clear of the end bents. A few minutes' wait was necessary to get the needed depth of water channel for this strange tow and its tugs. At 5: 47 the first move out was made.

Two tugs had taken position outside the scow groups and easily handled the floating span on the smooth water. The span came out as the sun was rising and was turned cross stream as it went out, so that by the time it was in mid-channel, at 6: 15, it was ready to move up the river.

The strong tidal current (6 miles per hour) swept the span upstream with little effort required from the two towing tugs. Five tugs downstream stood by, stern on, with lines in place and waiting to serve as brakes.

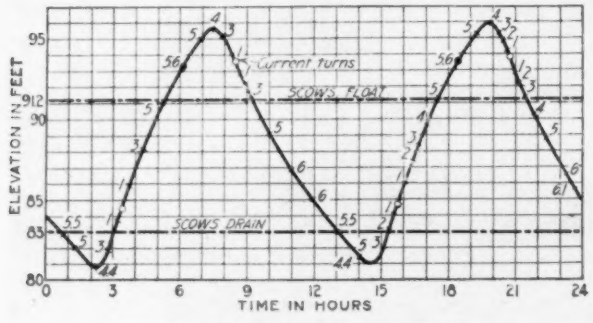
By 7: 25 the span was roughly in its place, and five minutes later the first lines were run out to the mooring trusses. In 18 min. the six lines at the end of the span were all out and the tugs were standing by with lines eased off. At 8: 05 the lifting chains, which had been drawn back, were let down and the ends appeared to be pinned in place in 20 minutes.

At 7: 30 the tide had turned, and by 8: 30 the current had shifted from upstream to down. By about nine o'clock conditions were right for beginning the 150-ft. hoist. At 9:10 the jacks started; the bottom chain pins came to the bottom of the lowest-link slots with the jacks a few inches from the top of the first hitch-adjustment stroke—which, being taken for more than half the lift without the load of the span, was not counted as one of the 75 lifts needed to do the work according to schedule. (Five such adjustment lifts were provided for beyond the normal scheduled operations in case any delays in connecting the hanging and stub links were longer than anticipated. In such an event the chains could have been lowered to connect with the span at any time down to low tide.)



EASE WITH WHICH APPARATUS WAS OPERATED GAVE EVERYONE CONFIDENCE

At the end of the third counted lift, at 10: 28, the scows came free and were swept from underneath by the current, the south-shore group preceding the north by a minute. The blocking beams between the span



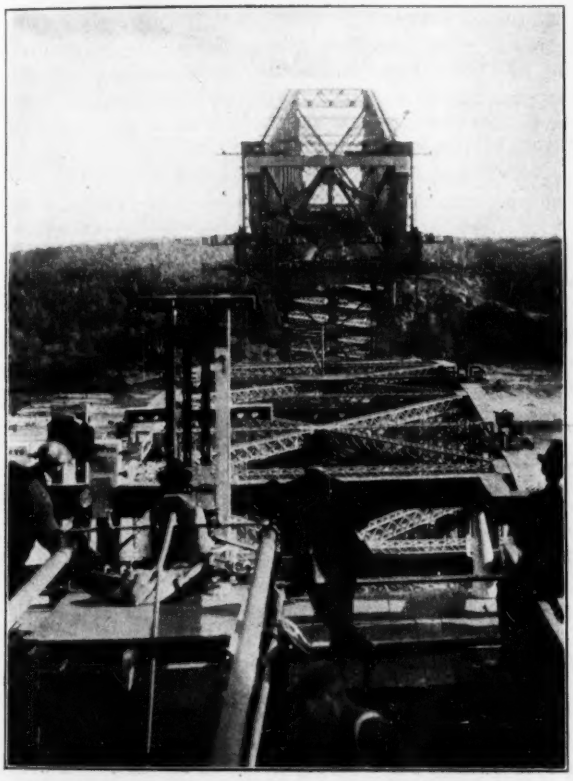
QUEBEC TIDE DIAGRAM FOR SEPT 17

Showing the rise and fall of the river and changes in current at all stages of the floating operations

and scows were not relieved of the load at quite the same time on the upstream and downstream sides, so that the barges began to swing around as they came out and for a moment gave some apprehension to those onlookers who did not realize the massiveness and strength of the hoisting details.

The imposing spectacle of the span hanging clear was received by the thousands on shore and on excursion craft in absolute silence—there was not a shout or a whistle. The feeling was tense, the scene most impressive. Everyone realized that the crucial test was at hand, for the work had reached this same stage last year when the span slipped from its supports.

Once the span was clear the men went in to a delayed breakfast. After an hour's intermission they returned, and at 11: 25 jacking was resumed. Two lifts were made and another recess was taken. The fourth lift was started after lunch, at 2: 05, and nine were made



THE SPAN GREW IN APPARENT PROPORTIONS AS IT ROSE

in rapid succession, ending at 4: 40. The actual time required for a lifting cycle varied from 13 to 19 minutes, and the actual lift period was from 6 to 8 minutes.

Up to this time there had been no wind, and the mooring tackle used to warp the span into its final floating position had not been shifted. For tying the span up for the night, however, the anchor lines were set, being better arranged for holding the span fixed.

The first task of the second day was the lowering of the top links, which had come through the top jacking girders. Taking off the pin caps, pulling out the short pins and lowering the links to the platform used up a trifle more than three-quarters of an hour. Jacking started at 8:16 and continued steadily to 12: 02, when the twenty-sixth lift had been taken. Another set of links had to come off after the noon hour, and it was 3: 40 before jacking began again.

During this part of the work there occurred the only accident of the entire job—and that was a minor one without anything more serious than an extra half hour's delay and a broken nose for one workman. For supporting the link-removal tackle, there were brackets bolted to the upstream jacking-girder box hangers, and several bolts on one at the southwest corner were

A CLOSE VIEW OF THE WHOLE HOISTING EQUIPMENT

sheared off. This was probably due to overloading, which was possible on account of the substitution, after the brackets were erected, of a heavy platform hoist for the light powered hoist mounted on the end diagonals of the cantilevers. The bracket was reinforced with slings and steamboat ratchets.

Seven more lifts were added to the score between 3: 40 and 5: 31, making the total number 34 and the lift 68 ft.

The third day was one of steady progress—of jacking interrupted only for letting down the top links as they came free. There was no wind, and the anchor tackles had to be shifted up the mooring truss only once, that being done at noon. In all twenty-six lifts were made this day, completing the sixtieth. This third day gave the appearance of the greatest progress to watchers on shore, on the river and even on the bridge. From all points of view the proportions of the span appeared to increase as it rose.

The fine weather broke just at the close of the second day, with a heavy shower that ushered in rising east winds. By Thursday morning the wind had risen to

25 or 30 miles per hour, and was coming in gusts. But a moderate pull on the anchor leads held the span in place, and it could be manipulated with ease to ½ in. or less. When allowed to hang free the wind held the span from 5 to 7 in. off center, the total length of the suspension system being 100 ft. at that time. A ½-in. longitudinal oscillation with a period of about 10 or 12 seconds was observed.

The jacking started at 9: 05 and by noontime (11: 53) ten lifts had been taken. Only 8 ft. remained to be covered when the recess was taken. The span portal was in full view; the upstanding permanent-hanger eyebars had come up through the jacking girders and were approaching contact with the eyebars suspended from the cantilevers.

The last afternoon's work started at one o'clock in an atmosphere alive with mingled excitement, expectancy, confidence and anxiety. The first afternoon lift, the seventy-second, was made in 15 minutes, and 5 minutes was taken for a look at clearances all around. The seventy-third lift was made from 1: 20 to 1: 40, and then 30 minutes were used up in taking down the inside free top links and a pair of angles across the lower box hangers, so as to secure the maximum room for driving the pins.

The seventy-fourth lift was taken very slowly (2: 10 to 3:10), as some of the wooden working platforms had to be taken down, the clearances inspected, and the eyebars guided into proper position interlaced. The seventy-fifth lift followed immediately, and locomotive cranes were run out to all four corners with pin-driving cages and pins. At the end of the stroke, at 3: 25, the first of the eight pins was driven. The clearances were perfect, and each long pin slipped through its eyebars with a few taps from a short rail swung by about ten men. Every ringing blow of the rails stirred the onlookers. And when at 4 o'clock the last foreman shouted, "Right, here!" all restraint among workers and watchers was lost. The crane whistles on the bridge picked up the men's cheers and the river boats passed the signal down to the City of Quebec, where (by the Mayor's proclamation) every whistle and bell and automobile horn was turned loose, and flags and buntings were thrown to the breeze everywhere, for Quebec realized that its dream of thirty years had come true.

But with the driving of the pins the day's work was not quite done. The jacks had to be lowered to let the load come on the permanent hangers and to let the lifting girder bearings come free—which they did with from ¼- to ½-in. clearance at the end of the seventy-fifth return stroke of the jacks. With this the day ended.

On Saturday the work of dismantling the hoisting equipment started and the wind-stress (pin-and-socket) connections between span and cantilever were brought forward. The span floor system has yet to be erected, the footwalks laid, and some lateral-bracing connections have to be riveted. Trains may perhaps pass over the bridge in six weeks, but the last work can barely be finished this year.

The story of the Quebec bridge has now been written. For one man, Phelps Johnson, who now retires from active work, it is the story of his last great effort. For many others, Duggan, Porter, McMath, Mitchell, Monsarrat, Modjeski, Borden, it is only the record of another achievement. For a score of younger men it is the inspiration of promising careers opened up by their notable work here under the guidance of the older men.

New Details Found in Quebec Span Hoisting Arrangement

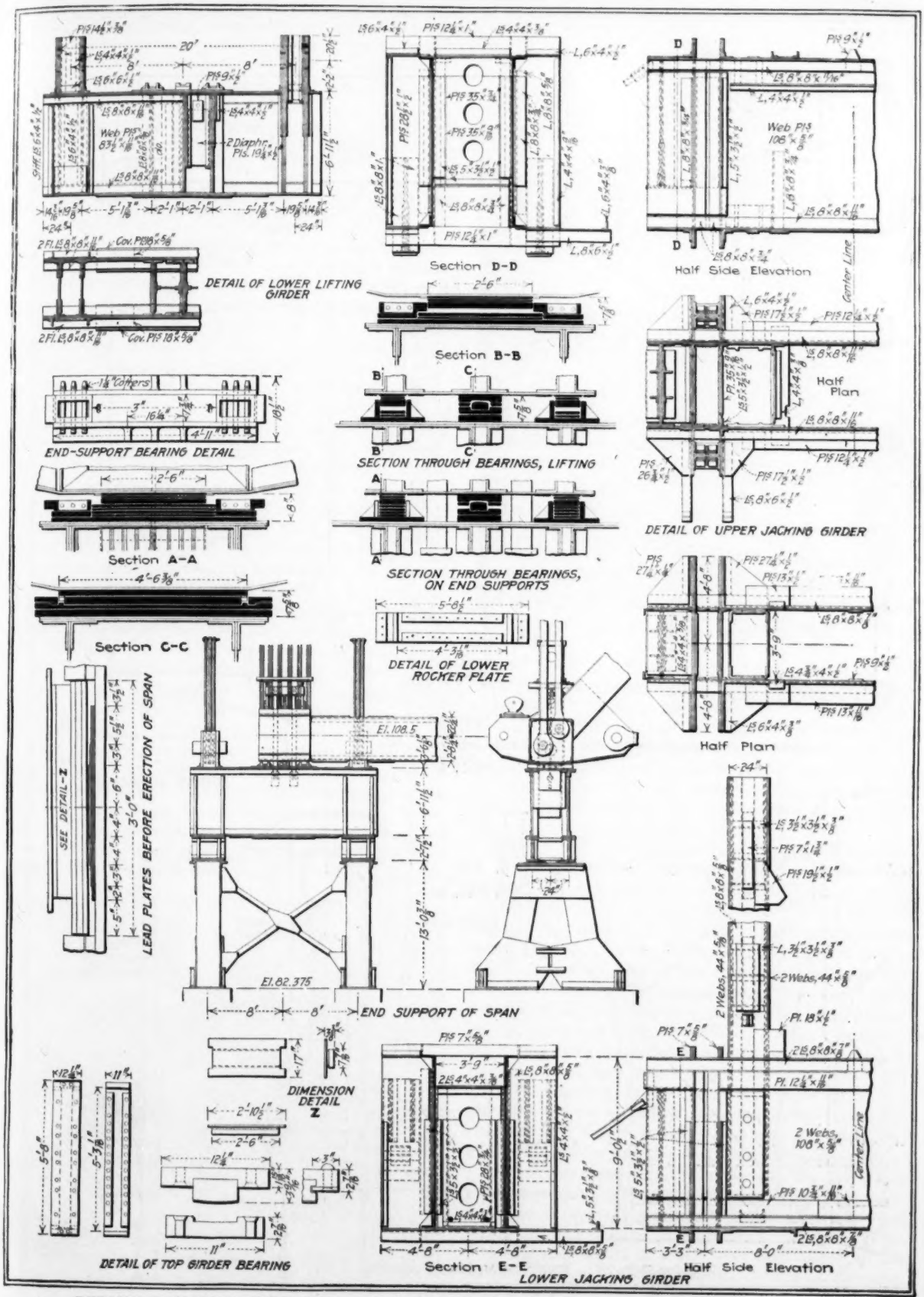
General Scheme Employed Last Year Retained, but Radically New Bearings Used Between Span and Chairs—New and Heavier Hoisting Links and More Follower Jacks

THE SCHEME and equipment for hoisting the new suspended span of the Quebec Bridge, successfully completed on Sept. 20, as noted elsewhere in this issue, follow the general practice employed in 1916, but with a few important modifications which the events of last year made advisable—though not all sprung out of the loss of the first span.

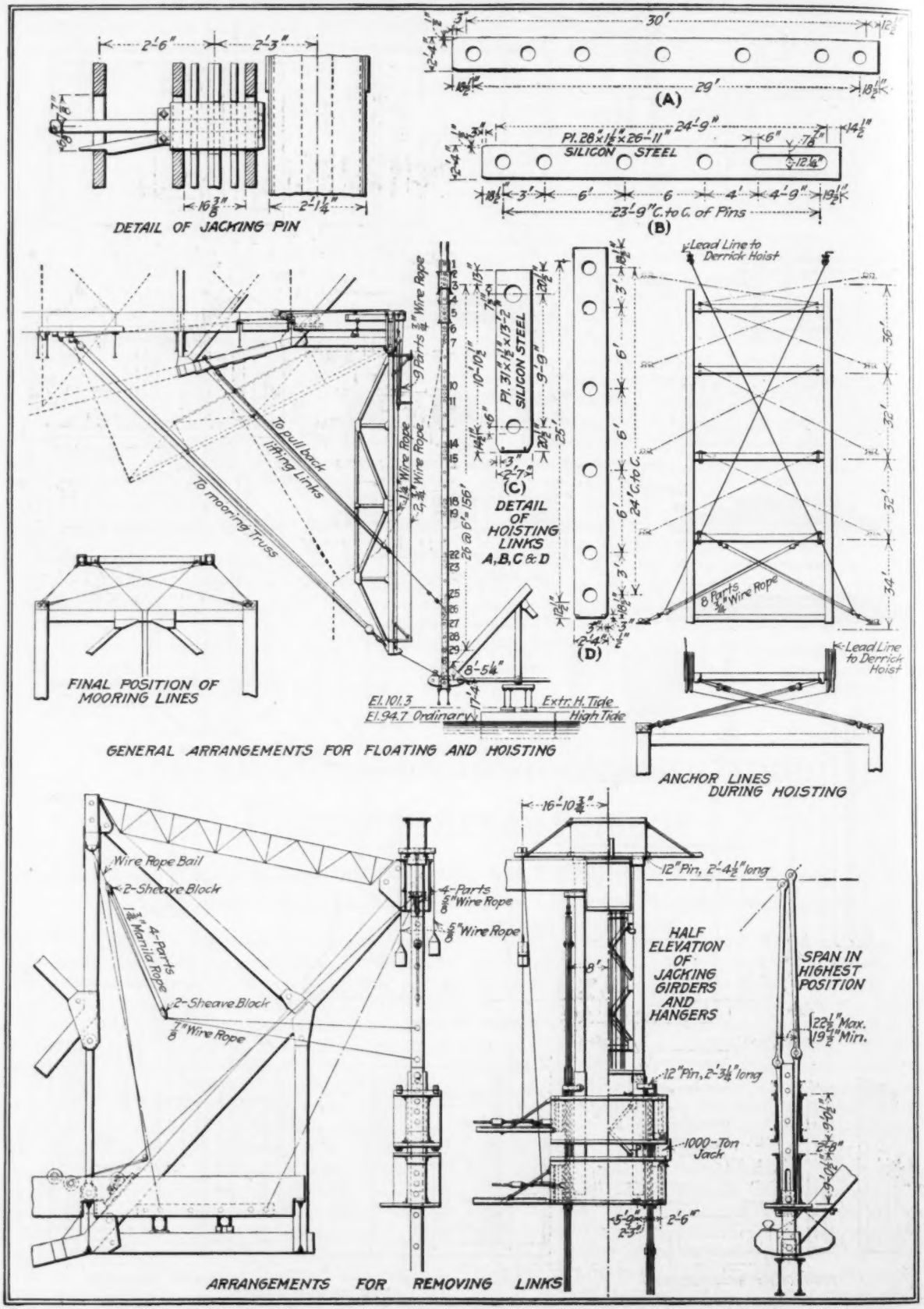
The new span is a duplicate of the old one—640 ft. long, 88 ft. wide and weighing 5400 tons. The task of rolling the steel (about 75% of which was nickel alloy), fabricating it in the shop and erecting it on falsework was completed in ten and one-half months—itself a notable performance in view of wartime demands for material and labor. The shopwork, if possible, was even better than that on the first structure, and the erection time was cut by ten days. The same site at Sillery Cove was used, and the same falsework and end supports. The identical six scows before employed for floating were used again.

It will be recalled (see *Engineering News*, Aug. 31, 1916, and *Engineering Record*, Sept. 23, 1916) that the program called for erecting the span on falsework over shallow water, lowering it upon its end supports; letting six scows, moored underneath near the ends, pick it up as the tide rose; towing it to the main bridge site; connecting lifting chairs carried under each corner to pairs of lifting chains hanging from the cantilevers, and then jacking the span as a unit until pins could connect the permanent hanger bars carried by the cantilevers and the span.

The corner chairs, or "lifting girders," as they have been commonly called although they were employed while the span was being erected, when it was resting on its four end supports at Sillery, and while it was being hoisted to final position between the cantilever arms, were the old girders used with the first span, but largely rebuilt to meet the needs of the different intermediate bearings between chairs and span corners. These girders



DETAILS OF LIFTING GIRDERS AND SPAN BEARINGS FOR ERECTING AND HOISTING QUEBEC SPAN



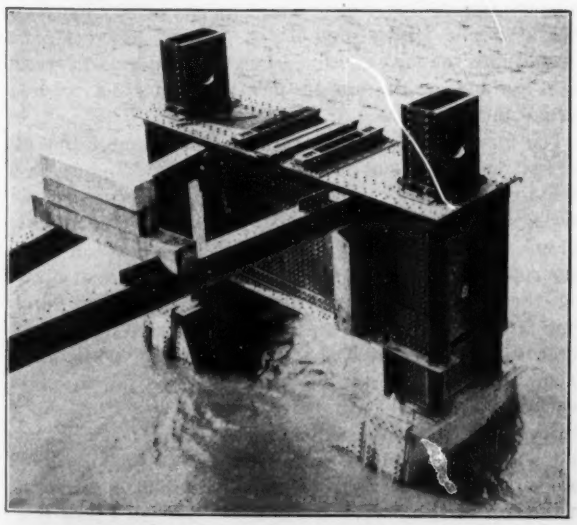
ARRANGEMENTS FOR FLOATING, MOORING AND LIFTING THE NEW QUEBEC BRIDGE CENTER SPAN

are briefly described as being built up of two plate girders connected by bearing and stiffening diaphragms and cover plates. They are 5 ft. 6 in. x 20 ft. in plan and 7 ft. in depth. Some details are shown in the accompanying sketches.

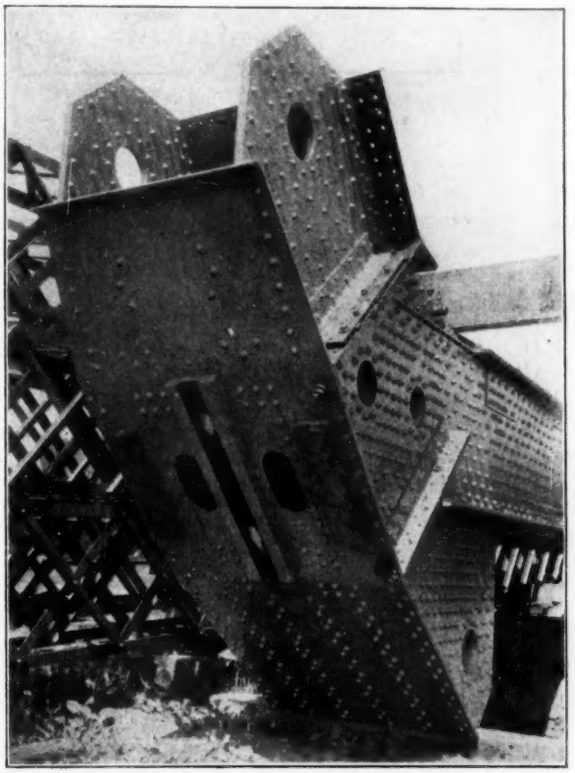
When the suspended span was swung on its fixed end supports, the load was concentrated at each corner upon two flat-plate bearings having their centers 4 ft. 2 in. apart, directly under the two outside ribs of the truss end post. Considerable sliding movement had to be accommodated, as the span elongated 4 in. as it was let down from its supporting falsework to the end supports alone. Then there was provided for a possible range of travel of $3\frac{9}{16}$ in. for each corner, due to expansion and contraction from temperature changes.

These plate bearings comprised a base—a machined steel casting, shown in detail in the accompanying sketches, in the pocket of which are six lead strips of varying length—and above these two steel filler plates, the lower one fitting the casting very closely to prevent extrusion of lead, and a bronze bearing plate on top of all. The lead strips were placed in initial position like the leaves of a carriage spring, so that as the load on the bearing increased during erection and swinging and as the inclination of the corner XLO changed, the lead would flow and give a firm seat for the bearing filler plates, and so provide uniform load distribution.

On each polished bronze top plate rested the polished face of a built-up steel bearing shoe, 2 ft. 6 in. long by $7\frac{7}{16}$ in. wide, bolted underneath the suspended-span corner. The upper steel filler plate and the bronze seat plate were held pocketed by finished and fitted guide blocks, each held in the bottom casting by three large cottered pins. The polished surface of the bronze plate was lubricated with paraffin before being placed. When the span was floated these bearing plates came out of contact and the lifting girder was then carried by a pair of small hanger links coming down from short channels on brackets attached to the gusset plates of the end diagonal. When the sliding bearings were free—that is, when the span was afloat—the bronze seat and one steel filler were taken out and the end blocks then turned around so as to serve as guides between the lifting girder and suspended span, in order that the girders might remain properly centered ready for the hoisting operation. These sliding bearings did not again take load when the lifting girder and span were picked up by the hoisting chain; they served thereafter only as guides and as emergency bearings intended to come into play in case of any accident to the single corner bearing employed during the lifting operations.



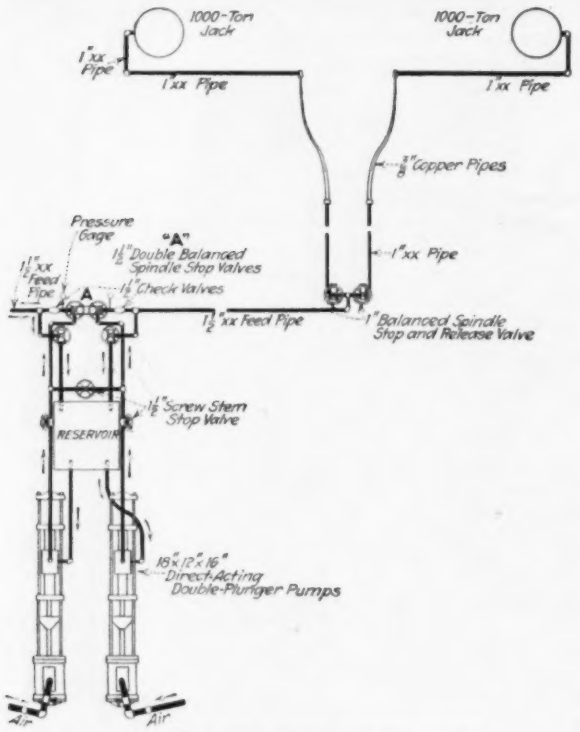
CORNER-BEARING POCKETS ON LIFTING GIRDER



SLIDING SHOES AND ROCKER PLATE UNDER SPAN CORNER

Between the slide bearings, and between the center of the lifting girder and the center rib of the span corner XLO, was the single bearing used during lifting (and idle during swinging and floating). This bearing contains no castings; it was fabricated entirely out of rolled material. On top of the lifting girder was first a $2\frac{1}{16}$-in. filler plate, and on this a machined holding plate grooved for end stop blocks and for a nickel-steel rocker 5 in. wide, $2\frac{3}{4}$ in. deep and 4 ft. 3 in. long, having its top surface a cylinder of 24-in. radius. A nickel-steel plate with machined groove to center the rocker was riveted to each span corner under the center rib. The centering stop blocks of this rocker were bolted into place after the span floated free, and together with the end blocks on the converted sliding bearing guided the nickel-steel rocker into the shoe under the span corner.

Each lifting girder during the hoisting was carried by two chains going up to the jacking girder. Each chain was formed by four strings of lifting links. In each string one link was 26 ft. 11 in. long, five were 27 ft. 1 in. and one was 32 ft. 1 in. They were bored for the 12-in. jacking pins at 6-ft. centers, with $\frac{1}{2}$ in. clearance transversely and $\frac{3}{4}$ in. longitudinally. The lifting links were bored in sets of sixteen, and each link had a



SYSTEM OF FOLLOWER SCREW JACKS

designated place in the chain, so that the spacing of pin holes at each end of the span was identical for each lift made. The lifting links were fastened together into a chain by 12-in. pins, 1 ft. 3/4 in. long, held in place by caps and through bolts. The links themselves were each 2 ft. 4 in. wide and 1 1/4 in. thick, and were not attached to each other except through the common bearing pins of each chain (four links). The allowable stresses through the pinhole were 18,000 lb. per sq.in., including stress from 20% of the load as impact and an assumed additional load of 500,000 lb. per corner to allow for possible differences of level between corners of the span.

The stub links and lowest section of the lifting links were made of silicon steel with an elastic limit of 50,000 lb. per sq.in. All other links were of carbon steel rolled to the same specifications as the material for the permanent structure—62,000 to 70,000 lb. ultimate strength. Full-sized tests of similar links developed an ultimate strength on net section through pinholes of 60,000 lb. per square inch.

The mooring arrangements were the same as last year. Six lines were used to guide and haul the floating span into final position between the mooring trusses hanging down from the cantilever end. Two lines came down from electric hoists on the cantilever to each mooring truss corner and spread out to the two corners of the span; and two came across from steam hoists on the floating span along the center to the end, and spread across to the corners of the mooring truss.

The only change was the provision made for replacing the mooring lines by an 8-part 3/4-in. steel line thrown from each corner of the mooring truss to the diagonally opposite span corner. As the jacking progressed, these lines could be held taut by derrick hoists on the platforms above. Each time the bottom of the span rose past a panel of the mooring truss, a 24- to 36-ft. lift these anchor lines could be shifted to the next higher anchorages on the trusses. This provision for anchoring at any time on very short notice was provided so that work could be stopped at any time and the span held against wind movement. The tackle was kept tight, however, only during the idle night hours and on the last day, when the wind was strong.

To facilitate connection at the slotted bottom hole of the bottom links in the lifting chain, the stub links borne by the lifting girders under the span corners had fastened at their top a pair of guide straps between which were cross bolts—one continuously in place and the other removable through a top slot. On swinging down the chains to engage the stub links the slotted links were brought up against the back guide bolt, and then the front bolt was dropped into its slot and fastened, leaving 3/4 in. total play between bolts and links. With the hanging and upstanding links thus guided, it was easy to slip home the 12-in. connecting pin.

The upper supporting girders, at the ends of the cantilever arms, were similar in design to the lower supporting girders, except for arms which carried various counterweights. Between the center of each girder and the center of the supporting arm is a rocker joint very much like the center bearing under the suspended span, the rockers in both cases being parallel to the bridge axis. At the top support the rocker was locked to the bearing plate on the supporting girder, and the cylindrical surface was down against the bearing plate on the cantilever.

Pinned to the upper supporting girder (at right angles to the span and thus, with the rockers, accommodating movement of the suspended span in any direction from external forces) were the box hangers, about 2 ft. 3 in. square, which came down some 44 ft. to carry the lower, or fixed, jacking girder. Each pair of box hangers was cross-connected by two panels of X-bracing. Coming up from each fixed jacking girder to meet these box hangers coming down from the upper supporting girders was a pair of cross-braced box hangers about 15 ft. long. The two sets of box hangers met at a pin joint. The lower pair of hangers was riveted into the lower or fixed jacking girder and served as a guide for the upper jacking girder as it was raised and lowered.

The fixed jacking girder carried on its center line at the extreme end, outside the supporting hanger, two 1000-ton hydraulic jacks, and four auxiliary, or follower, screw jacks on brackets in line with the lifting chains. The hydraulic jacks had rocking seats at both upper and lower bearings to accommodate, without binding, the deflection of the girders under load. The reaction from the hydraulic jacks was carried by transverse diaphragms in both jacking girders, while that from the follower screw jacks was borne through brackets to the main members.

Each follower jack consisted of a 12-in. screw, a nut and a barrel casting. Each barrel was supported by brackets on the lower girder, and the nut fitted a recess in the top of the barrel. The screw carried below it a vertical splined shaft by which it could be rotated. The

screw and shaft were supported on a clearance yoke below, from which two cables ran up to a similar yoke above. From the latter yoke a cable ran to a counterweight. Loose on the screw shaft, but restrained by guides on the lower jacking girder, was a feathered bevel gear meshing with a gear on a shaft going through other gears to a drum and handwheel carried by the lower jacking girder. As shown in the accompanying sketch, the two follower screws at each hydraulic jack were geared to one handwheel. Two men easily followed the movement of the upper jacking girder.

The lifting links passed between pin-bearing cross diaphragms in each jacking girder. The chains, as already noted, were bored every 6 ft. to receive a 12-in. pin, while the girder pin diaphragms were similarly bored on 2-ft. centers. There was ½ in. transverse and ⅞ in. longitudinal clearance in the chain holes, and larger clearances of 1 in. and 1⅞ in. in the pin diaphragms.

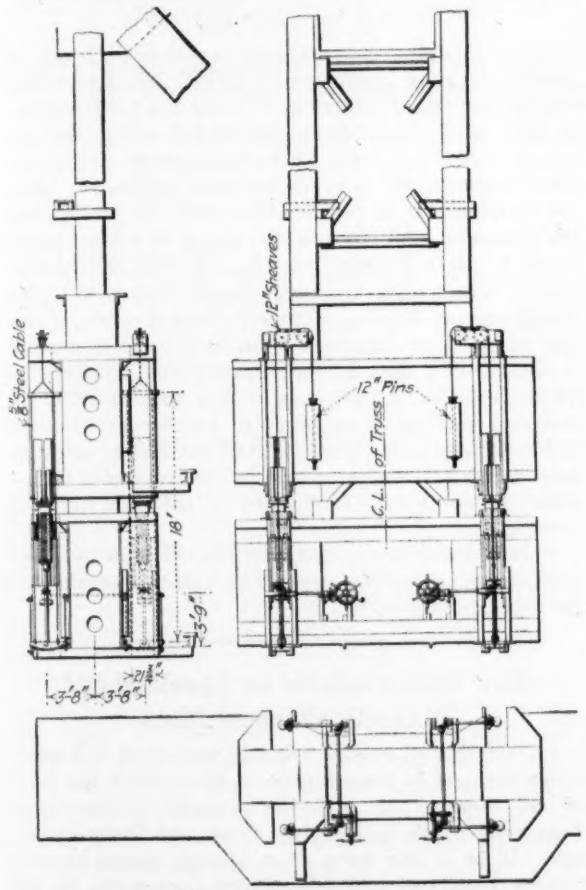


DIAGRAM OF HYDRAULIC JACK CONTROL

Each upward jacking movement carried the span up 2 ft., the platform pins holding the chains to the upper girder. At the end of the upstroke the lower platform pins were entered through the lower girder diaphragms and a registering chain hole. Then the jacks were eased off to let the load come on the lower pins, while the upper pins came out. After a return stroke of the jacks and the upper girder, the upper pins were reinserted and a new lift began, the lower pins coming out as soon as released from their load.

The two 1000-ton hydraulic jacks lifting each corner of the span were supplied at 4500 lb. pressure by a parallel pair of air-driven direct-acting double-plunger (18 x 2 x 16-in.) pumps drawing water from a wooden tank into which the jacks discharged on their return strokes. The stopping and starting of the jacks was controlled by the valves on the air-supply lines to the pumps, and no air or hydraulic receiver was inserted in any of the lines, the long lines coming over the cantilevers amply cushioning all shocks. Air was supplied by three motor-driven compressors, each with a free-air capacity of 534 cu.ft. per min. at 110 lb. pressure.

The flow to the various jacks was controlled by stop valves, used as throttles, in the first feeder line, in the distribution block (connecting one or both pumps to the east or west pair of jacks) and in the branches leading to each jack connection. The actual lifting and release of the jacks was in the hands of the central pump operator solely, the east and west valve men merely holding alike the travel of their two jacks.

All the connections on the cantilever platform were of 1½-in. *XX* pipe and fittings. The jacks were connected first to a 1-in. *XX* pipe on the jacking platform, and the platform systems were connected by double 16-ft. lengths of ¾-in. copper pipe in S-bends. All the hydraulic equipment was made by the Watson-Stillman Co., of New York City, and was set up under the direction of that company.

Telltales were placed before the three valve men on each end of the span. Each indicator comprised a pair of cords and counterweights, sliding on firm guides and carrying registering targets. The corner telltale cords came from the ends of the upper lifting girder; the cords for the center telltale came from the center of the same girder. Only the center indicator had a scale. On each central telltale board were mounted four incandescent electric lamps representing the four pairs of screw jacks. These were on a circuit which was broken at an automatic contactor when the follower screws were about ¾ in. below their uppermost position. Their chief use was in warning the operators when the follower screws had retired far enough so that the return stroke of the hydraulic jacks could be started.

Both end platforms of the suspended span during floating were connected to the central control platform of the span by telephone lines. When the span was moored these instruments were disconnected and the circuit was used as a line between the north and the south cantilever platforms. Each cantilever platform also had a connection with the main-office switchboard of the company.

The actual lifting operations were directed by W. B. Fortune, erection superintendent of the St. Lawrence Bridge Co., but under the general direction of G. H. Duggan, chief engineer, G. F. Porter, engineer of construction, and S. P. Mitchell, consulting engineer of erection. The Board of Engineers of the Quebec Bridge, representing the Dominion Government—C. N. Monsarrat, chief engineer and chairman, Ralph Modjeski and H. P. Borden—personally inspected the floating and hoisting.

Highway Commissions, Not Legislatures, Should Draft Traffic Regulations

By A. N. Johnson
Consulting Highway Engineer, Portland Cement Association

THAT adequate traffic regulations are necessary, and that such do not exist, is well evidenced by the amount of discussion that this topic is receiving in both the daily and technical press. Nearly every legislature has this subject before it for consideration. The present statutes on traffic regulation are voluminous, varied and wholly inadequate.

Traffic regulations may be divided broadly into two classes; those which conserve the safety of the traveling public, and those which conserve the highways. Speed, danger signal, light and similar regulations illustrate those of the former class, while regulations concerning the weight and size of vehicle are of the latter.

State Regulations Differ

Inasmuch as interstate travel, already large, is constantly increasing, it becomes a matter of considerable concern that the regulations, particularly those relating to the safety of the traveling public, should be, under given conditions, the same in every state. This is far from being the case at present. Inasmuch as these regulations are today a subject of statutory enactment, it is evident that there will be considerable practical difficulty to secure any degree of uniformity among the different states. Moreover, it will be agreed by all that traffic regulations of all kinds is a matter that requires a high degree of expert study, if they are to be such as will insure the results that should be obtained.

Such expert consideration, it is submitted, can scarcely be expected to result from such deliberations as a legislature or a committee of a legislature can give; but it is on such basis that practically all of these statutes rest. Discussions of this subject have brought out and developed many details as to the regulations to be enforced, but it will be necessary to make some fundamental change in the method of originating such regulations and making them of practical application, if the two essentials are to be secured, namely, proper regulations and uniformity under similar conditions in all states.

A Possible Solution

As a possible solution to this problem, the following is suggested:

First, traffic regulations, both as to the operation of vehicles and their weight and size, should be primarily promulgated by the state highway commissions of the different states, with the idea that the highway commissions would be best able to bring to bear the most expert knowledge that could be secured.

Second, it would be far more practical and possible for the state highway commissions of various states to coordinate their efforts and secure a degree of uniformity much greater than is possible by legislatures.

The statutory enactments that would be necessary to make such a proceeding possible would be along these lines:

The legislature of each state should pass a law that would empower the state highway commission to formulate traffic regulations and provide a penalty for the operation of a vehicle in such a manner as to endanger the life and property of others. Also, a penalty should be provided for such use of the highways as is likely to cause extraordinary wear or damage. It would be made *prima facie* evidence that a vehicle had not been operated properly or that a highway had been misused, if such operation or use was contrary to the rules and regulations of the state highway commission pertaining thereto. Such a statute would necessarily provide details as to the publication and promulgation of the rules and regulations of the state highway commission.

Speed Limits Not Defined

Under this plan the legislature would not attempt to provide definite speed limits, would not say which vehicle on meeting another at a crossroads had the right of way, what lights should be carried, what warning signals should be given, what the limits of weights of loads or the weight to be allowed upon a wheel, or what the limiting size of vehicles that could be moved over the highways. All these details would be given careful study by state highway commissions and be made a matter of regulation by them. Legally they would have significance as defining evidence. Thus a person would not be fined or imprisoned because he disobeyed a regulation of a state highway commission, but because he had operated a vehicle in such a way as either to endanger the life or property of another or to cause undue damage to a highway. And the test or evidence upon which his conduct would be judged would be the rules and regulations formulated by the state highway commission.

Under such a plan as this, there would seem to be the best chance of having proper and uniform regulations for traffic in all states.

New Data Available for Checking Old Magnetic Compass Lines

Information of special value to surveyors and engineers engaged in reproducing on the ground the lines of old surveys run with the magnetic compass has been made public by the U. S. Coast and Goedetic Survey. It is in the form of a 51-page pamphlet containing results of magnetic observations made by the Survey at 352 stations in 33 states and territories. Numerous old stations were reoccupied in order to determine the secular change of the magnetic elements, and many auxiliary stations were occupied where previous observations had indicated the presence of local disturbance.

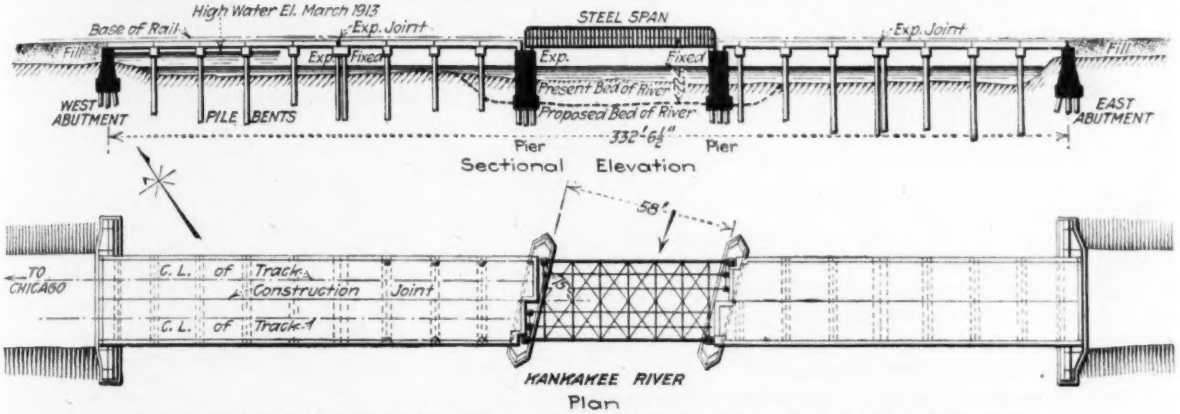
The results of the observations on land are given in tabular form arranged by states and territories alphabetically, for declination, dip and horizontal intensity, with the geographic position, and a separate description is given of each station occupied. A comparative table is given of the declination results at stations formerly occupied with the results obtained in 1916.

The publication may be obtained at a price of 10 cents from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Concrete Trestles Have I-Beams and Rails in Slabs

Removable Fixed Span in Erie's Two-Track Structure Over Kankakee River Will Permit Passage of Dredges

DOUBLE-TRACK concrete pile trestles, having slab decks which are practically I-beam spans incased in concrete, have replaced the old single-track timber trestles carrying the Erie R.R. across the Kankakee River near Lomax, Ind. The new trestles have just been completed in connection with the double-tracking of this section of the Erie, described in *Engineering News* of Feb. 8, p. 224. A feature of the construction is the inclusion of a removable fixed span to permit the anticipated passage of dredges. There are two trestles, 322 and 162 ft. long, crossing respectively the main and overflow channels of the river. The longer one is shown in the accompanying drawings.



CONCRETE PILE TRESTLES CARRY THE ERIE RAILROAD OVER THE KANKAKEE RIVER

The trestle spans are 16 ft. c. to c. of bents, the bents consisting of premolded concrete piles supporting concrete caps. At intervals of four or five spans there are double bents supporting caps of extra width, over which expansion joints are located in the deck slabs.

The piles are from 20 to 30 ft. long. They are of uniform octagonal section, 16 in. wide across the sides. The end is tapered for a length of 2 ft., ending in a 5-in. point. Each pile is reinforced with eight longitudinal round rods—¾-in. rods for piles 24 ft. or more long, and ⅝-in. for piles less than 24 ft. in length. These rods are surrounded with electrically welded hoops of No. 7 wire, spaced 6 in. c. to c., except that for 2 ft. at the head of the pile they are spaced 4 in. c. to c. Four of the longitudinal rods extend into the point, where they are brought together and wrapped with No. 12 wire.

The material in the river bed is mainly sand and gravel, with some clay. This made the driving of the piles with a Vulcan 5-ton steam hammer somewhat difficult, and a water jet proved of little assistance.

There are twelve piles in each single bent, spaced 30 in. c. to c. The double bents have two rows of piles spaced 30 in. c. to c. in both directions. The caps, cast in place upon the pile heads, are 42 in. deep, with a width of 30 in. on the single bents and 5 ft. on the double bents. They were made for each track separately, the two parts having a lapped joint at the middle, as shown.

The abutments are of plain concrete. Each is supported on three rows of timber piles, those of the front row being driven on a batter in order to brace the abutment against being crowded forward.

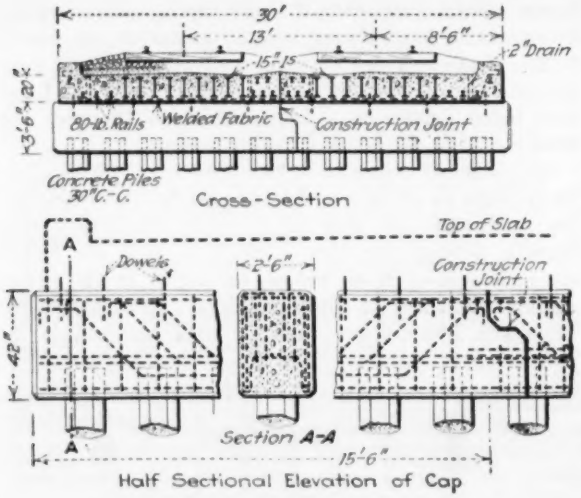
The concrete deck slab is 20 in. thick and 30 ft. wide. It is made in 16-ft. lengths for each track separately. In each slab are nine 15-in. 42-lb. I-beams placed directly beneath the ties. Old 80-lb. rails are placed on each side of these beams, as shown in the cross-section. A sheet of Clinton welded fabric, suspended from the I-beams and rails by wire hangers, is incased in the bottom of the slab and extends up into the curb wall on the outer side.

The slab and its reinforcement have a construction joint over each single bent, both ends of the slab being anchored to the caps by 1-in. dowel rods. Over each double cap there is a 1-in. expansion joint, the end of one slab being free to move, while that of the other slab is anchored as above described. This joint is filled with a non-hardening flexible material. Curb walls 6 in. high retain the ballast.

As the deck slab was built in two longitudinal sections (for each track separately), the inner side of each section was made 1 in. higher than the body, so as to throw drainage away from the central joint. The top of the slab under each track slopes ½ in. per ft. in each direction from the center of the track to a drain outlet. Each slab under each track has four 2-in. drain holes, formed by 2-in. pipe sleeves embedded in the concrete. They extend 2 in. below the slab in order to prevent the water drip from spreading on the bottom of the slab.

The concrete deck is covered with a waterproofing course of coal-tar pitch ¼ in. thick. Over this is a 1-in. layer of sand, upon which is placed the stone ballast, 8 or 9 in. deep under the ties.

The main channel of the river was straightened and dredged several years ago, and it is expected that it will be dredged deeper in the near future. An opening 58 ft. wide at right angles to the general direction of the river was therefore introduced in the trestle for the passage of the dredges and of large drift. This opening is spanned by a double-track through plate-girder bridge having two main girders.



DETAILS OF CONCRETE PILE TRESTLE

Provision is made in the construction of the concrete trestle adjacent to this girder span for support of a boom derrick to assist in lifting the bridge out. There is provision also for roller bearings on which to roll the bridge endways to permit the dredges to pass through, and to replace the bridge over the channel with the least possible delay to railway traffic.

This span is carried on plain concrete piers, so located that their faces are parallel with the general course of the river and at an angle of 75° with the tracks. Each pier is supported on three rows of timber piles. The piers are carried considerably below the present bed of the river, so as to be below the new bed after the river has been deepened.

One-half of each trestle (for the new second track) was built first, close alongside the old single-track timber trestle. When this part of the work was completed, traffic was transferred to the new track. The old trestles were then removed, and the second half of each concrete trestle was built.

The steam pile-hammer, noted above, was carried in leads swung from the boom of a locomotive crane. This drove the concrete and wood piles, and also the steel sheet piling for the cofferdams at the abutments and the two piers. In the construction of the south half of one of the trestles, however, the leads were supported on skids, as ordinarily used for a land pile driver.

All concrete was poured in place, with the exception of the piles. The concrete for the piles, caps and deck slab is a 1:2:4 mix. For the abutments and piers a 1:2½:5 mix was used. The concrete was made in a drum mixer of 15 cu.ft. capacity, which was kept close to the work. Wheelbarrows were used to carry materials from bins at the end of the trestle to the mixer, and to carry the concrete for placing in the forms.

The dead-load on each double-track bent is 182,500 lb.; the live-load (Cooper's E-60 loading) is 341,200 lb. With an impact allowance of 154,400 lb., this makes a total load of 678,100 lb. per bent.

These trestles were designed by F. A. Howard, engineer of bridges and buildings, Erie R.R.; A. M. Knowles is assistant engineer of bridges and buildings. The design and construction were under the direction of R. S. Parsons, chief engineer and assistant to the president, and R. C. Falconer, assistant chief engineer. The trestles were built by the Robert Grace Contracting & Engineering Co., of Pittsburgh. Most of the piles were made by the C. F. Massey Co., of Chicago, the others being made at the bridge site by the contractor.

"Best Buy" in Pavements Determined by Popular Vote

AN EXAMPLE of the policy of letting property owners decide on the type of pavement, instead of allowing the matter to be settled on its merits by the city engineer, comes from Frederick, Okla. One would conclude from the details that popular amusements are rare in Frederick. The following description is based upon a report by an "eye witness."

All members of the city council and a crowd of citizens that filled every seat in the court room and left many standing were present when the mayor called the meeting to order and stated that its purpose was to ascertain what kind of paving should be used. It was decided by the council that two votes should be taken: First a vote on the type of paving preferred individually, and after this vote was canvassed all types but the two having the largest number of votes were to be dropped and a decisive vote taken on which of these would be adopted.

Each paving company, or promoter, was allowed 15 min. in which its representative could present the merits of a particular kind or brand of pavement. Mr. H., representing bitulithic pavement, spoke first. He made a price of $2.34 per square yard. Mr. P., representing rock-asphalt paving, spoke next and quoted a price of $1.75 per square yard. He offered a $10,000 bond that the price would not be in excess of the one quoted. Mr. G. spoke for vertical fiber brick paving, offering it at a price not to exceed $2 per square yard. Mr. W., of the B. Asphalt Co., spoke in behalf of sheet asphalt and asphaltic concrete, but made a price of $1.85 per square yard on the latter only, as sheet asphalt was not under consideration. Messrs S. spoke for vibrolithic (cement concrete compacted by patented method) quoting a price of $1.74 per square yard.

Ballots were distributed, each property-owner voting for the kind of paving he preferred, noting the amount of frontage he had on the streets to be paved. One vote was allowed for each 25 ft. of frontage or fraction thereof. The result of the ballot was as follows: Vibrolithic, 409; asphaltic concrete, 273; vertical fiber brick, 17; rock asphalt, 4; concrete, 3. Vibrolithic was adopted without resort to a second ballot. The account concludes: "Coming in as an eleventh hour contestant the Vibrolithic Co., of Dallas, Tex., represented by four busy men, succeeded in convincing the property owners that they had the best 'buy' in paving goods."

Concrete in Sea Water Articles

Owing to the space devoted in this issue to the Quebec Bridge it has been necessary to defer one week publication of the second article of the series of R. J. Wig and L. R. Ferguson on concrete in sea water.

Sink 7700-Ton Drop Shafts To Exact Line and Grade by Dredging

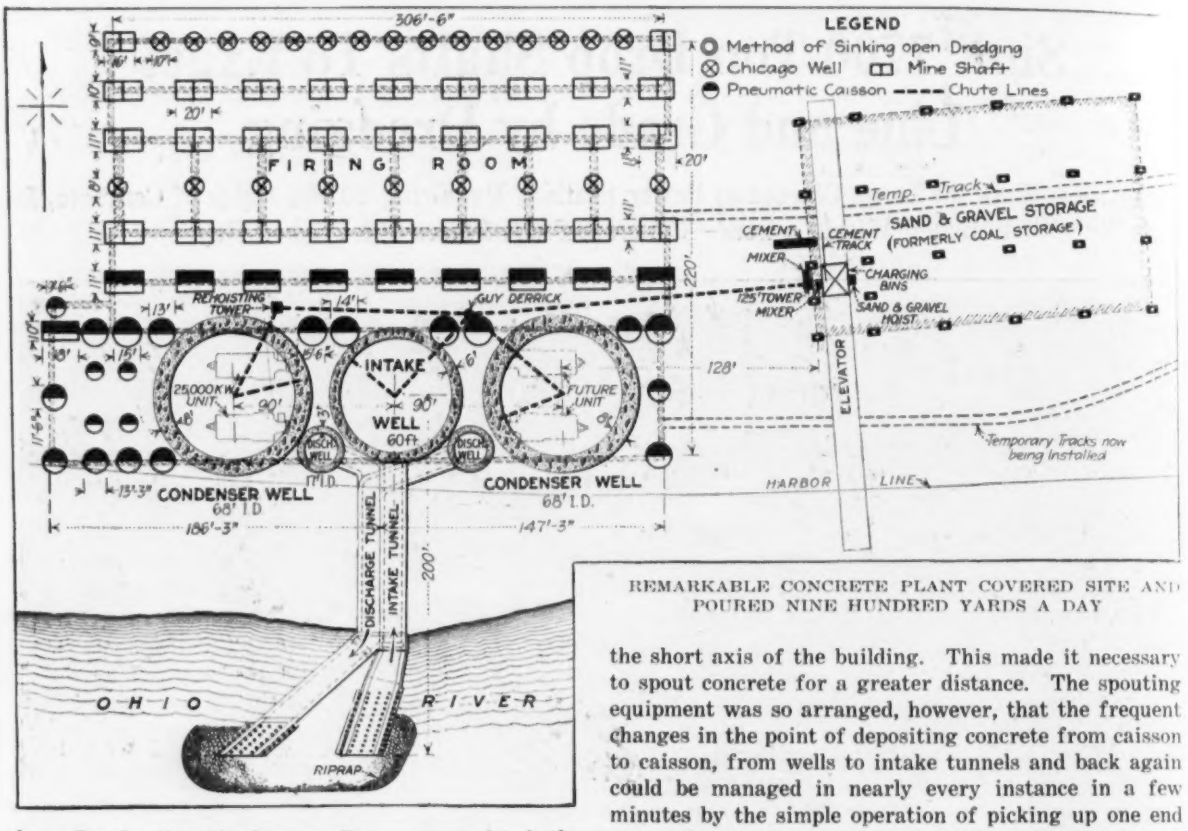
Foundation Work for Large Cincinnati Power Station, Requiring 50,000 Yards of Concrete, Is Finished Within a Year—Concrete Plant Places 900 Yards a Day

EXISTING COAL PLANT AT RIGHT CLEVERLY ADAPTED TO HANDLING CONCRETE MATERIALS

EXTENSIVE foundation work in which cofferdam, caisson, well and open-dredging methods have been brought into play, and which required 80,000 yd. of excavation and 50,000 yd. of concrete, has just been completed in less than a year in the course of the construction of a new steam-electric power station for the Union Gas and Electric Co., in Cincinnati. In spite of the size of the contract, it was entirely covered by a single spouting plant, cleverly adapted to make use of existing structures, which time after time poured 900 yd. every 24 hours without stop or breakdown. Either the caisson and well work or the cofferdam work alone would have formed a sizable contract, but in addition the unprecedented feat of sinking a concrete drop shaft 72 ft. in diameter and two 84 ft. in diameter concrete drop shafts by open dredging in sand to practically exact line and grade was accomplished. These huge cylinders, weighing from 6000 to 7700 tons each when landed, were handled with a nicety not believed possible at the time the contract was undertaken.

The new power station is located on a bank some 45 ft. above ordinary stages of the Ohio River. It occupies a rectangular space about 831 x 550 ft. The material encountered is from 30 to 40 ft. of cinder dump containing stone, scraps of old blast furnaces and all imaginable sorts of rubbish. Beneath this is sand or sand and clay, to a depth of about 40 ft. below the river bed, where a stratum of gravel which could be relied on for a foundation is encountered. The station is therefore carried on the intake and condenser wells, and on pneumatic caissons and open wells, all of which reach this stratum. The large wells, located in the middle of the river side of the station, are connected to intake and discharge tunnels extending into the river, which required for their construction the unwatering of the river bed within a typical Ohio River cofferdam. Large reinforced-concrete coal pockets through the boiler room along the north side of the building below the first-floor level also had to be constructed as soon as the piers were sunk and before steel erection could begin. The frame of the power station itself required about 6000 tons of structural steel.

As quickly as materials and plant could be assembled in July of last year, a start was made on the large cylinders, cofferdam work, caissons and well construction, and all were carried forward together as rapidly as possible. By the time the river cofferdam was closed and pumped, a good start had been made on the three big wells. As the open-dredging method by which these were sunk disturbed the ground in the immediate vicinity, it was advisable not to sink the pneumatic caissons nearest them until the large cylinders had been sealed. Accordingly, work was started on the two lines of circular open wells, as indicated on the foundation



REMARKABLE CONCRETE PLANT COVERED SITE AND POURED NINE HUNDRED YARDS A DAY

plan. By the time the large wells were completed, the five northerly rows of wells had been finished.

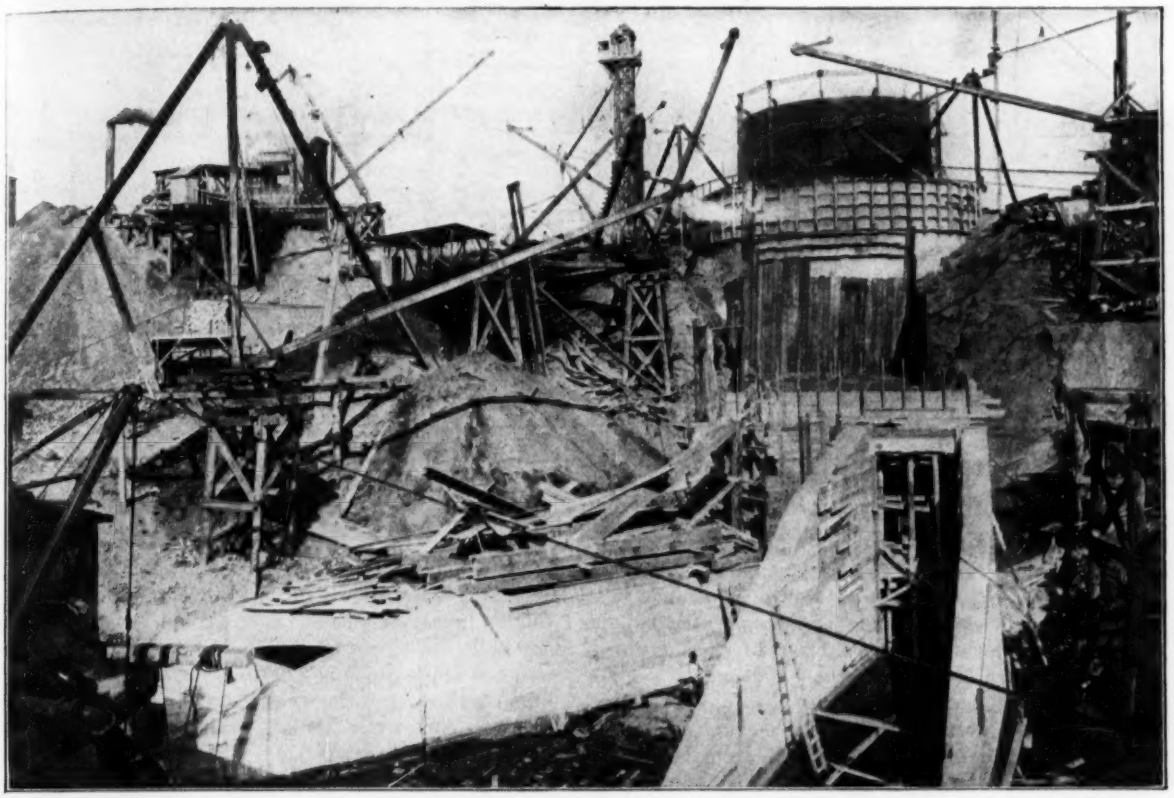
In the meantime, the intake and discharge tunnels had been constructed inside steel sheet-pile dams driven in the floor of the area unwatered within the box cofferdam, and the junctions with the openings left in the intake and discharge wells had been made. The caisson work, which progressed continuously from the time air was put on, as many as 18 caissons, wells and shafts being under way at one time, was then continued until the two discharge wells and all the piers around the large wells on the river side of the power house had been completed. Meanwhile, the reinforced-concrete coal pockets, erected on the first wells sunk, had been formed and concreted. This permitted the start of steel erection about Apr. 1 last.

The rapid work done in carrying on all these operations simultaneously at full speed has been, of course, made possible by the concentration of enough derricks, floating plant and other equipment to handle the work as fast as the physical limitations of the site would permit its being opened up. The largest single factor in this plant, however, has been the equipment for mixing and distributing concrete. While, perhaps, every single feature of this plant had been used before, it has proved extremely effective and is thought to be unique as a concreting layout.

The delivery of sand and gravel is by water from a dredge in the Ohio River. Both because the river cofferdam was in the way, and because an old coal-handling plant was available for taking the gravel up the bank and storing it at the east end of the work, the mixing plant had to be located on the long axis instead of on the short axis of the building. This made it necessary to spout concrete for a greater distance. The spouting equipment was so arranged, however, that the frequent changes in the point of depositing concrete from caisson to caisson, from wells to intake tunnels and back again could be managed in nearly every instance in a few minutes by the simple operation of picking up one end of one chute with a derrick and shifting it to the desired point.

The main hoisting tower, 125 ft. high, was located on the west side of the converted coal-storage plant, and concrete was spouted from it direct to a hopper built around the tall revolving mast of a guy derrick. This chute line remained in place throughout the entire work. The boom of this derrick supported a counterweighted section of chute, from the outer end of which a second chute was hung, which covered the easterly two-thirds of the building. When concrete was to be deposited at the western end of the building or down the bank inside the cofferdam, the chute line from the revolving mast was simply swung around and straightened out so that it discharged into the hopper of an 80-ft. rehoisting tower from which chute lines were strung as required. The lines from the rehoisting tower to the western condenser well and to the cofferdam required practically no shifting, and the chutes to the various wells and caissons at the west end of the site could be changed at leisure while concrete was being poured at some other point from the revolving mast.

The guy derrick was located on a line perpendicular to the common axis of the east condenser and intake wells, and the counterweighted chute reached the exact center of either well. The second chute, revolving around the end of the counterweighted chute, could travel all around the well as concreting progressed. This chute had a 10-ft. section which could be removed when the intake well was being concreted. The first section of chute suspended from the boom on the rehoisting tower reached the center of the west condenser well, so that it could be concreted in the same way.



LARGE NUMBER OF DERRICKS KEPT WORK GOING SIMULTANEOUSLY AT MANY DIFFERENT POINTS

It can readily be seen that with such a distributing system the work of changing chutes was not only reduced to a very low point, but could always be carried on without interrupting the operation of the concrete plant for any length of time. The effectiveness of this distributing system was proved time and again. On Apr. 17, for instance, 750 yd. of concrete was poured in 15 hours, during which the mixer scarcely stopped, the concrete being deposited in the intake well and in several different caissons.

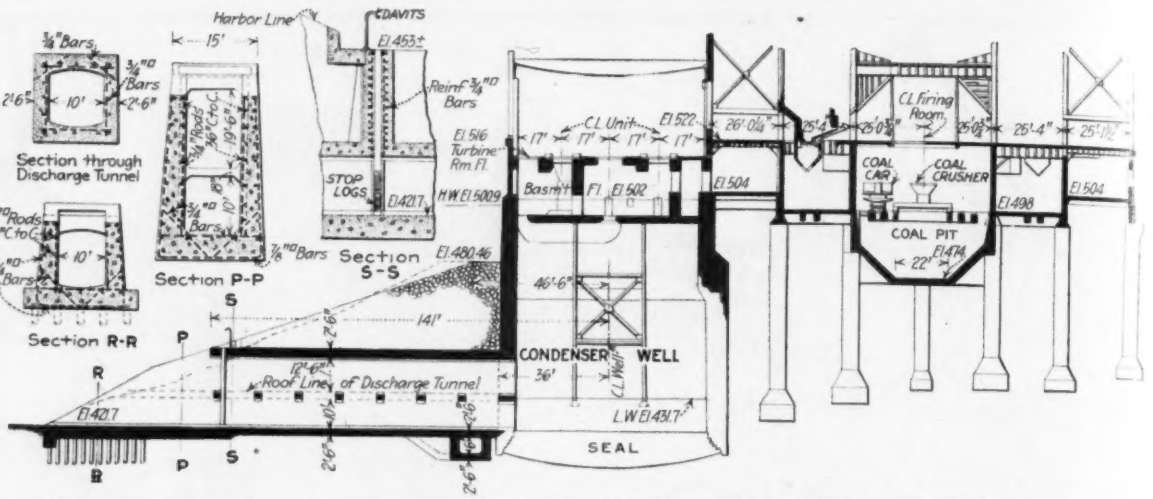
The coal pockets and incline used to receive gravel from the river and store it were formerly used by the owner of the power station in operating one of its gas plants. Gravel and sand are unloaded by derrick boats to a hopper on a float at the foot of the incline, which discharges into one of two cars traveling on the incline and handled by a hoist. These cars are turned at the top of the incline and run east under the roof of the steel frame shed which covers the coal-storage space. The gravel is dumped here to a stockpile on the ground. The total space available will accommodate 12,000 yd.

A slip scraper operated by wire rope and a hoist takes material from these stockpiles and dumps it into a pit which supplies the skip of a small tower erected behind the mixer. The sand and gravel are elevated by this skip to charging bins erected under the level of the roof, from which material can be drawn by gravity into the measuring hopper feeding the mixers. These bins hold 250 yd. of gravel and 150 yd. of sand. Cement, which is received by rail and stored in a 6000-bbl. shed, is hauled to the mixing platform up a slight incline on a platform car holding 40 bags.

Two concrete mixers were set up to insure continuous operation, one discharging into the skip of the main hoisting tower from the east side and the other from the north side. Both are of 1-yd. capacity. While the larger cylinders were being sunk, this plant frequently poured 450 yd. in one condenser well on the day shift and 450 yd. in the other on the night shift. The Lakewood mixer on the east side of the tower directly beneath the 400-yd. sand and gravel bins was the one used for these runs, the other being held in reserve and called upon only occasionally.

Although the caissons were not sunk to great depth, 24 lb. being the maximum air pressure required, they were not easy to handle, because of the sand soil through which they were sunk and the fact that each had to be belled out below the cutting edge in gravel. Frequently, as soon as the air pressure would be slacked for a drop, the caisson would take a plunge and fill the working chamber with sand. As the caissons were skillfully handled, however, no serious delays occurred in sinking any of them. Little weight was required, because of both the material and the depth. The weight used was limestone blocks from an old building which had been demolished on the site. A maximum compressor capacity of 3800 cu.ft. was installed, which took care of three of the caissons at once. The compressor plant was located at the bank of the river at the west end of the building.

Both of the small discharge wells were sunk as caissons, as were all the circular wells, except those in the north and fourth from the north rows, which were sunk by the Chicago well method. All the rectangular piers



FOOTINGS BELLED OUT ON GRAVEL—DEEP COFFERDAM WORK WHERE DISCHARGE TUNNEL PASSES UNDER INTAKE

were sunk by mine-shaft timbering methods. The caissons and shafts struck old concrete piles, which had to be cut off, and blocks of stone and slag. One caisson descended on parts of an old blast furnace, made of ¾-in. plate which had to be burned through.

Eight stiffleg derricks were used in sinking. Most of the derricks were equipped with skeleton hoists. A total of 725 boiler-hp. was concentrated on the job, including a dinkey and a locomotive crane. About half this horsepower was represented by a pump boat which had been constructed for use on government dam work on the river. After the box cofferdam was flooded, this pump boat was tied up at the west end of the job, and the boilers continued to supply steam for the compressor plant and derricks.

The large condenser wells and intake well were each dredged down with two derricks, using grab buckets. Contrary to expectations, the very size of these shafts was an advantage in keeping them level, and each of them was landed in a practically vertical position. On account of the slag fill and sand through which they were sunk, these huge caissons were expected to prove very difficult to handle. It was thought that they might jump and go some distance below where it was desired to stop them, or that they might rotate in sinking and throw the openings left to connect the intake and discharge tunnels out of line. None of these things, however, happened. The 1-ft. provision made for twisting and the 2-ft. provision for variation in grade were not required.

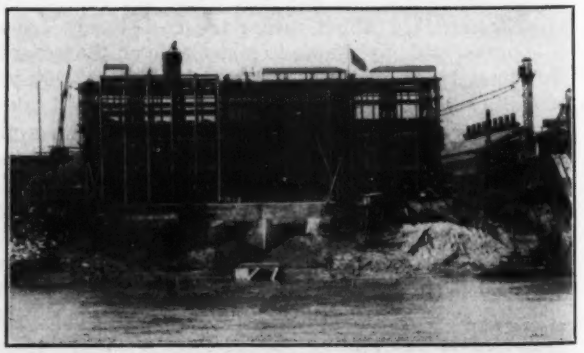
The maximum difference in either respect between the designed position and the position in which the cylinder was actually left occurred with the west condenser well. This cylinder, which struck the worst accumulation of slag, showed a tendency to plunge on the way down, dropping on several occasions distances of from 5 to 8 ft. in a few seconds. When, therefore, this well took a drop of 6 ft. and landed 4 in. above its final position, no effort was made to induce it to move farther.

On account of this tendency to drop suddenly, the concrete on these large wells was left 10 or 12 ft. low and completed after they were sealed. A comparatively small amount of additional weight could be added at any time if the wells failed to move as desired by putting on limestone blocks. Even though these wells were not built up before being landed, the two larger ones weighed approximately 7700 tons when landed, and the intake well reached the weight of 6000 tons before being sealed. This latter well was landed within 2 in. of grade all around and exactly in the position contemplated for connecting it to the intake tunnel.

In dredging down it and the east condenser well, the bottom was frequently excavated to an inverted cone 12 or 15 ft. below the cutting edge at the center. No jetting was required, as the sand came in nicely from all sides to the dredges. Considerable material ran in from outside these wells, the ground caving back in some places for 25 ft. In view of experience with similar work, however, the difficulty caused on this account was negligible.

The concrete seals placed in the large wells were each in the shape of an inverted dome. Each required 2600 yd., about two-thirds of which was placed under water before pumping out. The concrete walls and turbine foundations within the west well were then completed, the east well being left blank, as only half of the machinery installation is to be made at the present time.

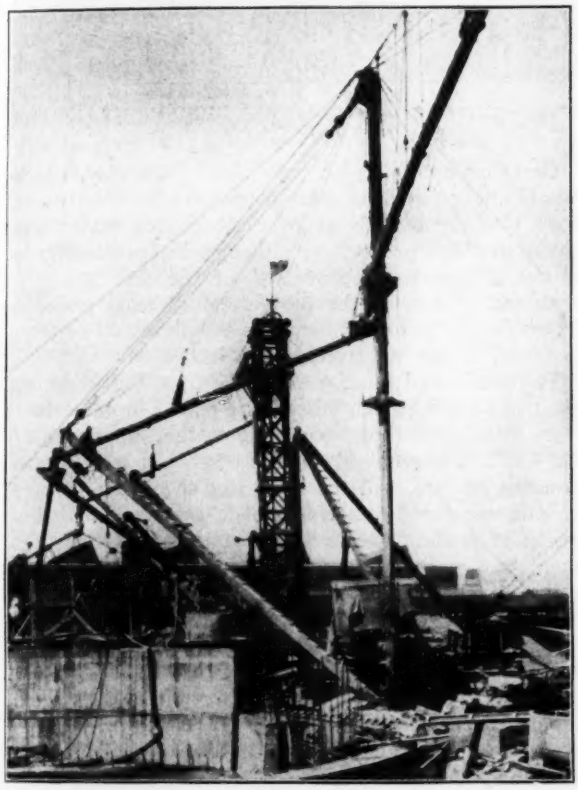
One of the condenser wells was landed Jan. 9 and the other Jan. 19, the intake well having been com-



STEEL ERECTION NEARING COMPLETION ON JULY 7

pleted last November. While sinking was in progress, steel sheet-pile cofferdams had been driven and excavated in the floor of the box cofferdam for constructing the intake and discharge tunnels. Where one of the discharge tunnels crosses beneath the intake tunnel, 60-ft. sheeting was required, and right next to the intake well, which was in place at the time, the excavation went down into running sand 50 ft. below river level. This was the deepest excavation on the job, and required extreme care. The steel sheeting here was difficult to pull, and much of it was abandoned.

The larger part of these tunnels was concreted before the large wells were sunk, the sections joining the tunnels with the holes left in the sides of the shafts being placed last. Two derrick boats were employed on the work, constructing the box cofferdam and unloading sand and gravel. The excavation within this cofferdam, however, was handled by derricks.



GUY DERRICK INCORPORATED IN CHUTE LINE

A spur of the Baltimore & Ohio R. R. runs through the property, and all plant and materials were received over this road. The railroad also accepted from the contractor the spoil from the cylinder and caisson excavation which could not be used at the site. Gondola cars were furnished, into which the dredges and caisson derricks dumped, the cars being set out by the contractor's dinkey for the railroad.

When the caissons had all been sunk the derricks were in position, with the assistance of the locomotive crane, to dig the coal pockets out again and dump the sand where needed to level up the site. If the amount which it was possible to store in this way should fall short, the contractor can complete the backfill with spoil from an extensive conduit system which is being constructed in connection with the power house, under a later contract.

The designers of the new station are Sargent & Lundy, consulting engineers, for whom H. M. Walmsley is resident engineer. The Union Gas & Electric Co., which owns the plant, is represented by its consulting engineer, C. R. McKay. The Foundation Co. contracted for the power station complete except for the installation of machinery, and is carrying out the work with its own forces. W. B. Taylor and George V. Salle have been successively superintendent of the work, while William U. Smick is general foreman. The contract has been handled by the Foundation Co.'s Chicago office, of which Frederick W. Adgate is manager.

Concrete Floor Tested to Destruction

Removal of a reinforced-concrete eight-story warehouse building to clear the site for the new Union Station at Chicago, has been made an opportunity for testing one of the floors to destruction. The building is about 107 x 120 ft., with flat-slab floors. Four adjacent panels on the sixth floor were selected for test by loading with pig iron.

The panels are 19 ft. 4½ in. by 17 ft. 5½ in. c. to c. of columns. Each panel has four-way reinforcement (rectangular and diagonal), with 15 high-carbon steel bars ⅝-in. in diameter in each reinforcing band. These bands are 7 ft. wide. The slab is 8½ in. thick, made of gravel concrete, 1:2:4. The columns are octagonal. Those of the fifth floor are 24 in. in short diameter, with 21-in. core; those of the sixth floor are 21 in. in diameter, with 18-in. core. Their caps are 4 ft. 6 in. in diameter at the top. Each column has eight 1¼-in. round rods, wrapped with ⅜-in. wire in a spiral of 2½-in. pitch. The floor was designed for a live load of 250 lb. per square foot.

The test loading consisted of pig iron, stacked in four piles on each of the four panels. It was applied in increments of about 200 lb. per sq.ft. until a total of 910 lb. per sq.ft. was reached. The first load was applied Aug. 16 and the last Aug. 28. Readings of deflections of concrete and steel were taken for each increment of loading.

The maximum deflection was 1.1 in. The approximate stresses at the maximum load were as follows: At column (Col. 22), 31,000 lb. in direct rods and 52,000 lb. in diagonal rods. At center of panel, 23,800 lb. in direct rods and 18,400 lb. in diagonal rods. Deformation in the concrete around Col. 22 indicated by flaking of concrete that at certain gage lines the ultimate strength of the concrete had been reached. These figures are the result of preliminary computations and may be changed when the computations are completed.

The structure is the Western Newspaper Union Building at Adams and Clinton Sts. It was built in 1909-10. S. N. Crowen was the architect, and Ritter & Mott were the engineers. The George Hinchliff Co. had the contract. The test was made under the direction of Prof. A. N. Talbot, of the University of Illinois, with H. F. Gonnerman in direct charge. Permission for the test was given by the Chicago Union Station Co. and the W. J. Newman Wrecking Company.

Ohio River Gravel Makes Good Roads in Kentucky

Mixed with 15% of Clay, It Gives a Surface That Quickly Becomes Compacted—Material Is Pumped from River

AFTER considerable experimenting, it has been found in Kentucky that very fine gravel roads can be built of river gravel, or washed gravel, as it is sometimes known. Three counties in western Kentucky are now devoting practically all their funds to roads of this type, although for a period it looked as if such roads never would be satisfactory.

The river gravel used in Daviess, Henderson and Union Counties is obtained from gravel bars in the Ohio River. It is composed of rounded water-worn pebbles ranging in size from fine sand to stone fragments 2, 3 or 4 in. in diameter, although the largest size does not predominate. The pebbles are hard, flinty

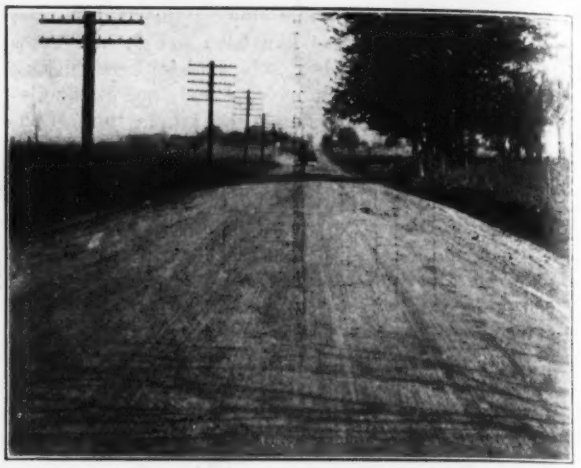
RIVER GRAVEL OF ROUNDED PEBBLES MAKES GOOD ROAD

stones mixed with some granite and a little sandstone. The sand is sharp quartz and, of course, is entirely free from clay.

This material is pumped by suction dredges and is delivered to the screens in a steady stream of water.

The first road built with this river gravel contained very little sand, and from 20 to 25% of clay was added. This road required a very long time to "set-up" or bond, and it was not until the action of traffic combined with several heavy rains, after eight months, that it finally did become hard; but since then it is asserted to have been in almost perfect condition. An effort was made to roll the gravel after the clay had been added, but the roller sank down into the gravel and had to be pulled out with teams. There was very little attempt made on the early roads toward harrowing the material in place.

Profiting by this early experience, W. S. Canning, division engineer, Kentucky State Highway Department, hit upon an idea of mixing the material exactly as the aggregates for concrete are mixed—with a 1:2:4 mixture, substituting clay for cement.

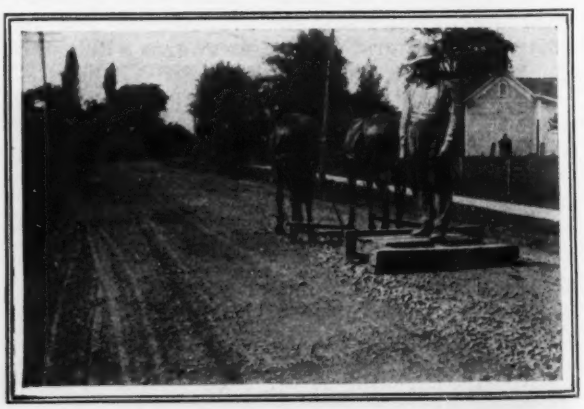


RIVER GRAVEL ROAD WHICH REQUIRED EIGHT MONTHS TO "SET UP"

Carrying out this idea gave about 15% clay, which Mr. Canning found by correspondence with county and state highway officials all over the United States was about the best proportion, although he, personally, is of the opinion that about 10% of the clay is amply sufficient. Likewise the percentage of sand under ¼ in. was made 25 or 30% and the remaining 50 or 60% is gravel in size not exceeding 2 inches.

The gravel and sand, which come from the screening plant in barges already mixed, are placed in one course from 6 to 10 in. thick, according to the importance of the road. The required amount of clay is then spread over the surface, and the road goes through a process of harrowing and dragging which, combined with the action of traffic, sets up and binds the gravel in only about two weeks, although it undoubtedly takes considerably more time thoroughly to compact the surface.

It has been found impracticable to use a steam roller to any extent, for it is next to impossible to roll the rounded gravel with it. Mr. Canning believes that in the process of harrowing and dragging with a split-log drag the gravel could be placed in three courses of 3 or 4 in. each and the clay thoroughly incorporated, so that by sprinkling, as in water-bound macadam construction, followed by rolling, the gravel surface could be permanently bound and the road completely compacted during the period of construction.



DRAGGING FIRST COURSE OF GRAVEL ROAD

Mental Values Derived from Study of English Are the Essentials

Emphasis Placed on Subject Matter by Professors Aydelotte and Park Likely To Hide the Fact That the Fundamental Need Is the Ability To Write with Accuracy and Compression

By EMERSON GRANT SUTCLIFFE
Instructor in English, University of Illinois, Ill.

PROFESSOR PARK of the University of Cincinnati and Professor Aydelotte of the Massachusetts Institute of Technology have discussed in the *Engineering Record* their quite different methods of solving the problem of how the engineering student should learn to write. Professor Park believes in correlation in this as in engineering education generally, and therefore in narrowing the student's range of topics to those directly technical in nature. Professor Aydelotte, on the other hand, leads the student as rapidly as may be away from engineering, and stimulates him to write on matters of opinion political, social, ethical, esthetic. Their methods agree, apparently, only in the assumption that the problem of the engineering course in writing is one of subject-matter: Shall the student write on topics closely connected with his profession or on those of broader cultural value? But is this the fundamental question? There is, I believe, an entirely different avenue of approach, broad and straight, which leads much closer to a satisfactory solution. It is the street of mental values.

Let me preface my explanation with a statement of underlying principles, axioms perhaps.

Engineering English Is Primarily Practical

(1) The course in writing for engineering students is primarily practical, as practical as mechanical drawing; it is cultural only secondarily. Though freshmen and even upperclassmen, ignorant of engineering, believe this reluctantly, and though so-called inspirational or esthetic methods of teaching the subject do not help to change their unbelief, they must some day discover what every engineer knows: The engineer must write, and therefore he must know how to write. Writing is not a thing remote from practice, a monstrosity and instrument of torture inseparable from themes; it is a part of his business.

(2) The two chief qualities of expression needed by the engineer are accuracy and compression. So far as these are concerned, it makes no great difference what the subject-matter is so long as the student is held rigidly to saying exactly what he means in as few words as are consistent with clearness.

(3) Professor Park's method of correlation has the exceeding merit that the student governed by it must regard writing not as a separate entity, divorced from life, but as a part of all his work. It has the additional value that it must awaken all but the unfit to the fact that writing is a practical engineering subject. The weakness of the system is that it hems in the student and in that way narrows his opportunities for mental training.

(4) Professor Aydelotte's system of developing the student's general culture is strong where Professor Park's is weak and vice versa.

(5) By way of balance: In general, the good teacher can succeed with any congenial method.

Both Technical and Cultural Subjects Should Be Included

It may perhaps seem that compromise ought not to stop here, that a mixture of technical and cultural subjects is desirable. Such mixture certainly results in cooperation on the student's part and hence has a persuasive value; it wins for writing the interest of all types of students: The narrow-minded who never want to get away from engineering either because they have no other interest in life except carburetors or because they fear that attention devoted elsewhere may mean a dollar less some day; the broader-minded, who regard engineering as a profession and not a trade and the course in composition as a chance to get cultural advantages; and the largest group, those who, if only for human reasons, like variety.

There is much to be said, too, for combining Professor Park's and Professor Aydelotte's methods in another way. At many engineering colleges it is the practise to devote one hour a week to a general engineering lecture, the principal intention being to familiarize the freshman in a broad way with his future profession. There may well be a correlation of this course of lectures with the course in writing, and to this extent Professor Park may be followed without any possibility of cabining, cribbing, or confining the student. On the other hand, such correlation is not entirely inconsistent with Professor Aydelotte's plan. If the instructor wants to dabble in the philosophical or the sociological, he does not have to stray far from the professional field proper, for there are such questions as engineering ethics and the relation of engineering to society. I use the word *dabble* to express what must be a fact; it is impossible for the ordinary teacher of writing to know much about either politics or ethics, or, for that matter, about engineering ethics—not to mention finding room for the expression of such knowledge. At the same time I recognize the suggestive and stimulative value of amateur or even dilettante discussion of such matters. And the topics may profitably be more specific: I have not disdained to ask for themes based on such topics as "At what age should the engineer marry?" "What salary has the engineer a right to expect immediately after graduation?"

But after all, this is not at bottom a question of subject-matter; it is a question of mental values.

The course in writing, like other engineering courses which are distinctly practical in nature, should have two main purposes: It should teach what it sets out to teach—how to write; and it should, so far as is consistent with the nature of the subject, develop those mental qualities which the engineer will find most useful. The significant fact is that accomplishment of the second aim means accomplishment of the first. I shall try to demonstrate that the course cannot develop proper mental values without at the same time teaching the student how to write, and furthermore how to write in the way which is most serviceable to the engineer.

What mental qualities does the engineer particularly need which training in writing can best cause to grow in him?

Perhaps the two most valuable are the twinscrew powers of analysis and organization.

Report Writing Is Most Important

The most important kind of engineering writing is the writing of reports. Reports require: First examination and investigation—analysis; secondly, proper ordering and relationship of the results of the investigation—synthesis or organization.

Double ability of this kind is indispensable also in connection with clerical systematization; of which the engineer, like every other business man, must avail himself.

Nor is the need of analysis and organization confined to matters that involve writing. The engineer is an organizer. He cannot organize unless he has everything in its place—in its proper relation to other constituent elements, and in relation to the whole. Laymen are satisfied with Mr. Hoover as food administrator and General Goethals as head of the ship-building program, though perhaps Mr. Hoover could not himself raise a corn crop or General Goethals give detailed directions for building a catboat. We laymen think of them as organizers, men who get things done and done well because they can size up a whole situation and its parts and know how to assemble men and material in the best way to meet the demands of the situation.

Can the college course in writing do its part, however humble, in helping to develop the mental powers of such men? Readily. Outlining and abstracting, whether of themes the student is to write himself or of essays and articles he reads, cannot but bring out and foster the power to divide and unite logically, to practise the sense of proportion. Similarly useful are the making and the assembling of notes taken on reading in the preparation of longer themes, and in addition these are directly worthwhile drill for the engineer whose studies do not stop after graduation and who in various other instances, more immediately practical, needs to take notes and put them together. Argument, especially formal argument with its disciplinary brief, furnishes excellent training of a like kind.

Several Types of Themes Are Available

Themes of the following types give exercise to the analytical and synthetic faculties:

(a) Classification: Whether of gasoline engines, farm workmen, co-eds, high school teachers, or religions.

(b) The root-principle or purpose of a mechanism, process, or organization in relation to its parts: Wireless telegraphy, getting out a high school annual, the Red Cross Society, the commission form of government, the Gary school plan, the Epworth League, democracy.

(c) Criticism, preferably not literary or artistic; that is, evaluation, judgment by standards: Anything from "The —— as a Doctor's Car" to the success or failure of a certain advertisement.

(d) The statement of a problem—the social evil, say, or the submarine.

(e) Arguments in which one process or material for a certain purpose is compared to another or others: Heating systems, roofing, unlimited debate or closure.

The Thought-Process Is the Important Point

It should be noted here that in any case it is not the nature of the topic which is important, but rather the processes of thought.

For the sake of deepening in the student's mind the grooves of analysis and organization, it might seem at first sight that report-writing could be advantageously taught. And so it can, but hardly in the usual freshman course. For there, in addition to such assignments as I have mentioned, there is a vast heap of detail to be attended to—essential detail: Spelling, punctuation, grammar, sentence-structure, paragraphing. I believe firmly that a course in report-writing, probably including and led up to by further themes, analytical in nature, of the type mentioned above, should be required of every engineering student—but it should be required in addition to the freshman course. Anyway, "that's another story."

Partly because analysis and organization are of such importance and partly because they are typical of engineering mental qualities which the course in writing should stimulate, I have chosen to discuss in detail their relation to engineering and to writing. The course has, or may readily be made to have, other mental values. In being thus far so definite, I have not meant to neglect the general quality of logical accuracy. No one needs more than the engineer the power to think straight—unless it is the writer. All writing goes back to the brain; and it is, therefore, first of all essential that the student should be strictly held to account whenever his sentences evince failures to think clearly, definitely, precisely, and completely. Assertions without proof should be rigorously challenged. Some of the other common fallacies should be discussed, and if possible there should be still further discussion of the more serviceable and everyday principles of logic. The brief should bring home to the student, if nothing else can, how painful and also how necessary it is to think accurately. General statements should be supported by specific examples, whether in an exposition of how to make hay, or an artistic description of a hayfield. The general word, too, should never be accepted when the specific is more precise, as it is, almost always. Definiteness should be the cry, for what profession requires more definiteness than engineering? And nowhere can mental precision, clearness and sharpness be checked up so stringently and so convincingly as in writing.

Some of this may be new to engineering readers, but I already hear my fellow-instructors clamoring: "Of course, of course. This is the height of triteness. We all do these things." I must now disclose a subtle pur-

pose which I had in mind in the very beginning. I intended to make clear in the course of these remarks not only that the college course in writing should be approached from the point of view of mental values, but also that these mental values result from it to some extent in nearly every case, no matter what system is used. I have been trying to demonstrate that the course is practical indirectly, as well as directly.

I recognize also that most of the mental qualities here named are valuable to the man in every profession and business, but I fail to see why, for that reason, they are less necessary to the engineer and to the engineering student's course in composition.

Other desirable mental characteristics which the course in writing may profitably encourage in the engineer are tact, the habit of observation, and imagination. The engineer must win the coöperation of his subordinates; he must obtain the goodwill and support of his superiors; and he must soften the obduracy of city councils and of legislative committees, national and state. Tact is essential. The course in composition misses a shining opportunity if it does not impress these facts upon the student. He may be asked, for instance, to write a conciliatory but firm speech which the leader of a labor organization delivers to an employer, demanding an increase in wages and threatening a strike as alternative; or the employer's speech to the workmen, in which a soft answer turns away wrath. Ability to put oneself in the other man's place may also be indirectly induced by imaginative description and narrative of a less definitely practical type. Description is, however, chiefly valuable because it makes evident the practical importance of seeing straight, of the power of observation; and because, like narrative, it furnishes incentive to the imagination. Need I dwell upon the necessity of the engineer's keeping his eyes open, or upon the fact that none of the great engineering enterprises would have been either thought of or carried out without the starting and executive power of imagination? This is usually constructive imagination, of course, of which analysis and organization are indispensable parts.

Under any circumstances, it is, as I have tried to suggest, the demands that the writing makes upon the student's brain and not the topic that is important. One can instil valuable habits of thought in the engineer's college course in writing no matter whether he believes, with Professor Park, that the collegiate day's work furnishes the best kind of material, or whether he agrees with Professor Aydelotte that incursions into wider fields of thought bring most profit, or whether he takes an intermediate position. Is not, then, the subject-matter of subordinate moment? Should not the character of the course in writing be governed by the mental qualities of especial value to the engineer which the course most naturally and capably trains?

Eleven States Have Civil Service

Civil-service commissions are maintained in 11 states at a total expenditure of $358,486 a year, according to information gathered by the U. S. Census Bureau. The 11 states are: Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Ohio, Illinois, Wisconsin, Kansas, Colorado and California.

Put Twenty Thousand Men Under Roof in Two Months

Motor-Truck Transportation Prominent in Work of Housing Regular-Army Increment at Chickamauga

WORK was started May 20, eight days after the signing of the contract, on wooden barracks for 30,000 of the volunteer troops just added to the regular army. In completed sections of these barracks 20,000 troops had already taken up their training quarters before the end of July. The encampment, located on the Georgia-Tennessee line in the historic Chickamauga Park, consists of several groups of buildings housing from one to three regiments each, scattered within a radius of four miles from Lytle, where the quartermaster storehouses for the encampment are located, and from which most of the construction materials were distributed by motor trucks. This method of transportation was made possible by the good macadam roads existing in the park.

Frederick Snare, of the contracting firm of Snare & Triest, reached Chattanooga on May 18, and began placing orders for material. On May 20 local yards delivered to the site a million feet of lumber by motor truck, and actual construction was begun. The work was taken up a section at a time, each brigade or regimental camp being pushed to completion as soon after it was started as possible. The first regimental quarters to be finished were occupied June 18, and thereafter troops moved in at frequent intervals until by July 24 thirteen units, with a personnel of 20,000, were in camp.

About 18,000,000 ft. of lumber will be used in the entire work, which includes substantial additions to the hospital of the regular army post at the park, and the quartermaster warehouses which are under construction at Lytle. Most of this lumber was ordered direct from mills in Alabama, Tennessee and Georgia, and is re-

GOOD EXISTING ROADS HELPED LUMBER DISTRIBUTION

ENCAMPMENTS CONSIST OF ONE-STORY BARRACKS BUILDINGS—SHOWN HERE IN PART—ACCOMMODATING TWO REGIMENTS

ceived by rail at Lytle, where temporary sidings aggregating about a mile in length were put in. These tracks parallel one of the main highways in the park, from which all of the encampment sites can be reached by good roads. The average haul is about 2½ miles. Platform trucks of 3½ and 5 tons' capacity have handled practically all of the hauling, about 30 being used.

All the 13 sawmills used in framing the lumber for the barracks buildings are located at the work, one being used in each camp site, and the remaining mills being shifted about as needed.

Chattanooga city water is used, a 500,000-gal. concrete-lined reservoir and ten miles of new water mains being necessary for the distributing system. These and the ten miles of sewers required are being laid in trenches dug by hand. All the sewage is carried to a disposal plant, where it is treated in septic tanks and pumped over sand filtration beds.

A force of 2000 men, recruited for the most part in Chattanooga, has been steadily employed. Most of the men get out to the work, which is ten or twelve miles from the city, by trolley or railroad, though several hundred live in the contractor camp near Lytle. The work is organized with a superintendent for the buildings at each encampment, for the reservoir, sewage disposal plant, pipe lines, and for transportation. The general superintendent for the contracting firm, Snare & Triest, is F. S. Maxwell. The surveying and other engineering work is being carried out by the contractor's forces with F. J. Letter, chief engineer, in charge as engineer. In addition, the work receives the personal attention of Frederick Snare, president of the firm. The camp is being constructed under the direction of the Cantonment Division of the Quartermaster General's Office, and is in direct charge of Maj. E. S. Walton as Constructing Quartermaster.

Texas Roads Damaged by Army Operations

County roads in El Paso County, Texas, following last season's military operations to the East and "Big Bend" country, required repairs exceeding $130,000 on a 60-mile stretch of earth and gravel surface. Truck trains of 26 motors each operated over this road, carrying supplies to the army, but there was also an enormous amount of drilling of the green company drivers for the 3000 machines located at Fort Bliss. Practically all of the small wooden bridges were stripped of timbers which the drivers used in extricating trucks from sand or mud. In repairing these culverts 80,000 ft. b.m. of timber was used, but this included many replacements of stringers that were found in a decaying condition. A large proportion of the money was spent for regrading, scarifying, rolling and hauling in new gravel.

There is no possible way for the Government to reimburse the county. However, a fund exists which allows the army officers to have work done to repair damages, and the payrolls for the road crews to a certain extent were handled in this way. Destruction of the roads is considered a good thing in a way in El Paso, because it forced reconstruction of a large mileage, which would otherwise have been in an indifferent state by now, on this the only outlet from El Paso to Fort Worth and San Antonio. The work was done under the direction of L. White, road engineer for El Paso County.

Why Require Fineness in Hydrated Lime

The current tentative standard specifications for hydrated lime of the American Society for Testing Materials require a fineness of 85% through a 200-mesh screen and 99.5% through a 30-mesh screen. Inasmuch as hydrated lime is an extremely fine material, there has been some wonder why such comparatively low prescriptions have been made. Norman G. Hough of the Hydrated Lime Bureau writes in explanation that the 30-mesh sieve provision was added merely to rule out limes with impurities, such as quarry sand, kiln brick dust, etc., all of which are deleterious in amounts greater than an arbitrarily placed minimum of ½%. The 200-mesh provision was merely to insure a finer lime than a standard cement, which must pass 78% through a 200-mesh. This insures a finer material in mortars, stuccoes, etc., where hydrated lime is mixed with cement.

Louisiana Reclamation Project Grows To Seven Thousand Acres

Little Woods Lands Take Rectangular Development—Town Plots Given with Grove Tracts—Soil Brings Construction Difficulties

By A. M. SHAW
Consulting Engineer, New Orleans

THE RECLAIMED LANDS of the New Orleans Lake Shore Land Co. (a stock company formed by local business men) now comprise about 7000 acres lying close to New Orleans. Late in 1912 the company decided to adopt a broader plan of development than had been followed for the few hundred acres first drained. Cultivation required the canals and ditches to be laid out on a rectangular scheme. The existing steam pumping plant was inadequate for the larger area, and a new electric station was built near the middle of the district. The combination of alluvial deposits and muck had to be considered in digging the canals and building the pumping station.

The tract has a frontage of seven miles on the south shore of Lake Pontchartrain and has an average width of two miles. Various agencies have contributed to produce a varied set of soil conditions in this tract. The entire surface of these Little Woods lands, with the exception of a slightly higher strip of ground along the lake front and two small lagoons in the interior, was originally at about mean water level of Lake Pontchartrain. The typical wet prairie lands of the lower Mississippi delta have a top soil of 2 to 6 ft. of muck mixed with silt, over a subsoil of "sharkey" clay, which is an alluvial deposit similar in texture to true clay.

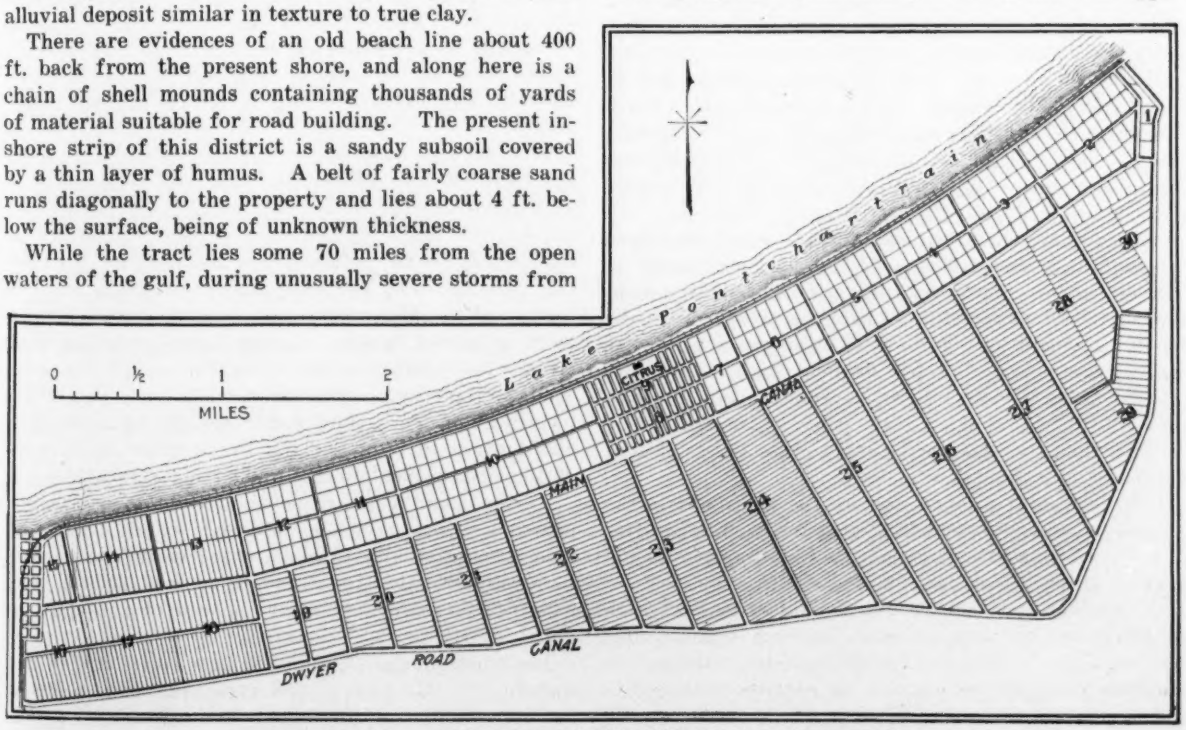
There are evidences of an old beach line about 400 ft. back from the present shore, and along here is a chain of shell mounds containing thousands of yards of material suitable for road building. The present inshore strip of this district is a sandy subsoil covered by a thin layer of humus. A belt of fairly coarse sand runs diagonally to the property and lies about 4 ft. below the surface, being of unknown thickness.

While the tract lies some 70 miles from the open waters of the gulf, during unusually severe storms from the east and southeast quarter, the lake water has been known to rise 5 ft. above ordinary level, necessitating levee protection. The most exposed front is protected by the double-track embankment of the New Orleans and North Eastern Railway—a barrier 8 ft. above normal lake level.

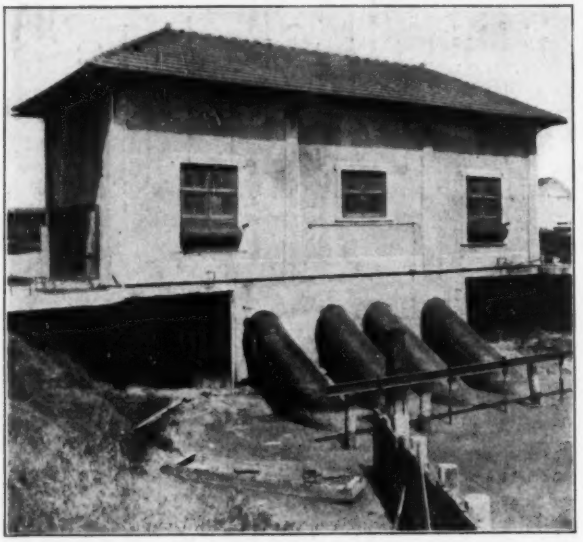
The eastern levee was constructed by the project owners to a top grade of 28.00 (Cairo Datum, mean lake level being 21.2). This levee has since been incorporated in the protection system of the City of New Orleans, and its reconstruction to El. 30 has been undertaken. A levee was built by the tract owners along the rear of the property, but this will not be required after completion of the work undertaken by the city.

Excessive shrinkage and subsidence were encountered in building across the deep muck deposits, but this was held down by constructing in multiple layers. Test pipes, attached to broad plank platforms, were placed in the levee line for determining the subsidence of the foundation, and valuable information is expected to be derived.

These protection levees were constructed of material from canals outside the protected and drained areas. A few projects in this locality have followed the oppo-



LITTLE WOODS GROVES LIE IN RECTANGLES ABOUT THE TOWN



STEEL SHEET PILING SUPPORTS WALLS AND CUTS OFF SEEPAGE

site plan, utilizing the borrow pit canals as a part of the interior, low-level canal system, but the excessive danger and trouble from seepage and the difficulty of repairs to levees so constructed have made the outside canal plan seem preferable.

A main drainage canal has been constructed through the property at a distance of half a mile from the lake shore. This canal is 45 ft. wide through its central portion and gradually reduces to a width of 30 ft. at each end. Its average depth is about 8 ft. below general land level. Lateral canals are spaced ½ mile apart, leading from the rear of the property to the main canal. These are each 30 ft. wide and 7 ft. deep. A 60-ft. trunk canal connects the main canal with the central pumping station.

Field laterals have been constructed along each of the division lines between the five-acre groves into which the property has been subdivided, the average spacing being about 165 ft. These laterals were usually dug 3 ft. deep with a top width of 4 ft. and bottom of 2 ft.

A radial system of drainage canals would have been objectionable here from an agricultural standpoint on account of the difficulty of cultivation of the large number of small groves into which the tract was to be split. In these soils, systems of open-field ditching are necessary to secure proper drainage and ditches are spaced at such close intervals, usually about 10 rods, that all cultivation must be along lines parallel to them. Even as laid out here, in rectangles, these lands present serious difficulties in cultivation.

The hydraulic gradient assumed by the water in the canals is so slight, when the canals are well filled after storms, that any shortening by a radial system would not be of appreciable benefit.

It was also desired that the individual groves (each of five acres) should be as nearly unifrom in dimensions as possible. In this way the desirability of the groves depends only on the location as regards nearness to town, existing roads, and the lake front; the selections, therefore, have been normally made along certain fairly systematic lines so that the work of breaking up and planting has been as nearly contiguous and continuous as possible. This has resulted in an economy of development which, it is believed by the sales department of the owners, would not have been secured with the haphazard system of selection and improvement which would have resulted from the radial layout.

The sketch map shows that blocks have been reserved for villa sites and a commercial reserve in the town of Citrus at the lake-front center of the tract. The sales of all lots of five acres have been made with the idea that they would be planted in citrus fruits, and usually only one five-acre lot to a purchaser. No provision has been made in these five-acre tracts for a residence site, for the purchase of each lot carries with it the transfer of a 40 x 100-ft. villa site in the town reserve.

This scheme has been planned to bring about a concentration of the homes so that the planters would have the advantages of real community life. The promoters of the district have been to considerable expense in bringing city water out to this reserve, and good drainage, sewers and electric current are all available. The one defect that can be urged is one of omission. Much is still to be desired in the artistic arrangement of the building lots, parkways, etc., compared with the layouts which have been proposed for some other communities of similar nature.

In designing the discharge canal, the railroad company, which passes along the lake front of the tract, constructed a pile trestle for the outlet of the water under their tracks to the lake. It was agreed with the railroad company that the owners of the project would guarantee freedom from scour of this canal or of the ends of the railway embankment. A section was adopted which would result in a velocity of 1 ft. per second when both pumps were operating and when the lake was at normal level. Observations have now been taken frequently for two years and show no appreciable change in section either by scour or by accretion, though a considerable mud flat has formed in the lake in front of the plant.

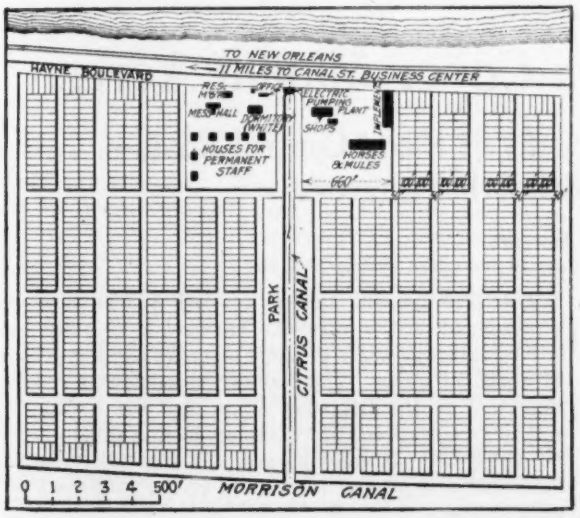
Trouble was experienced during the early part of the Little Woods development (as has been the case with all similar projects in this section) in maintaining the dredged canals to satisfactory depth. The loss in section was due to various causes, but principally to fine ooze brought in by the field ditches, to caving of canal banks and to upheaval of canal bottoms from excessive loads on waste banks. Caving banks have not been an important factor in loss of section, except where the sand stratum was encountered. At such points the movement of the ground water brought in a considerable amount of sand and the banks caved as a result of the displacement of the supporting stratum.

As the canal velocities never exceed and seldom approach 1 ft. per second in the larger arteries, no relief from these difficulties can be expected through scour. It is estimated that the interior canals of such a tract will require redredging after the end of the third or fourth year.

The pumping plant building is 25 x 60 ft. in plan and contains, in addition to two pumping units, a 5-ton, hand-operated, traveling crane and two motor-driven vacuum pumps for priming the main units.

In deciding upon the type of prime mover, consideration was given to steam, internal combustion engines, and electric motors. Judged solely by questions of first cost and economy of operation, the advantage appeared to favor internal combustion engines of a fairly high grade, but it was found that by adopting electric power other advantages could be gained, and this was finally selected. By making a long-term contract with a local company, it was found that a favorable rate could be secured and current would be more easily made available for lighting and miscellaneous power service of the town. Without a large power contract, it would not have been feasible to secure current, as five miles of new transmission line were required.

The two main pumping units are of identical design, each consisting of a Worthington centrifugal pump driven through herringbone reduction gears by a 215-hp. motor, operating on a three-phase 2200-volt alternating current. The discharge end of the pumps is novel, being 48 in. vertical diameter and 54 in. horizontal. It was adopted in an effort to harmonize the conditions imposed by the speed of the motor and the desire to keep the nozzle velocities within reasonable limits. The suction and discharge pipes are belled at their extremities, so that the approach and discharge velocity will not exceed 4 ft. per second. The plant has a guaranteed efficiency of 52½% overall between the switchboard and



LAYOUT AT LAKEFRONT CENTER OF TRACT

the canal when operating against a state head of six feet. The guarantees for efficiency were exceeded on test.

As the building foundation formed a dam between the suction and discharge basins, steps were necessary to prevent seepage through the porous substrata. Interlocking sheet steel piling was used. Pieces were 30 ft. long, and were depended on to carry the weight of the building walls, the top of the piling being incased in the concrete footing. The rear line of piling was carried well beyond the limits of the building to prevent seepage around the end. The machinery foundations rest on round pine piles, cut off below permanent water level.

About 40 miles of shell roads have been constructed on the property so far, all of the shells being secured from the mounds along the old lake shore line. Roads along the lake front and on the tops of the canal waste banks are constructed by placing the shells directly on the earth after it has been properly graded, but in building across the flat prairie lands it is necessary to cover the sub-grade with a layer of cheap cypress planks before spreading the shells.

As already noted, the land company is a stock concern formed by local men. In 1912 Prof. W. B. Gregory, of Tulane University, was employed to examine the property and make recommendations for a general plan to reclaim the entire tract completely and at an early date. In the year following, the writer was employed as engineer and general superintendent, Professor Gregory being retained as consulting engineer. The bulk of the construction work was completed in 1913, and agricultural work was then started on a large scale. A contract was made with the firm of Symms & Means, of San Francisco, for the management of the property, the writer being retained as engineer, and A. R. Weber being the resident manager representing Symms & Means.

Bituminous-Joint Brick Pavement Still Preferred

Excellent Results with Asphalt Joints at Warren, Ohio, Explained by C. H. Lawrence, City Engineer

THE City of Warren, Ohio, has what are believed to be some of the most perfect brick pavements to be found in the state, and these have been constructed almost wholly with bituminous joints. In spite of the fact that for a number of years the tendency has been almost universal toward cement-grouted joints and latterly toward the monolithic type of construction, many paving engineers in the very heart of the brick-paving country still prefer bituminous joints. The reason for this preference was recently summarized as follows by C. H. Lawrence, city engineer of Warren, for a member of the editorial staff of *Engineering News-Record*:

"Like many other engineers and contractors I have talked with, I am adverse to using cement-grout filler for two reasons. One is that the checking and cracking of the pavement cannot be avoided or overcome by the use of expansion joints, particularly in very wide streets; and the other is that on residential streets grouted pavements are apt to be noisy and this, to my mind, is very objectionable in a first-class residential district. This, of course, leads us to the use of the filler, which will overcome the first objection and eliminate the second objection to a very large extent at least.

"We have confined ourselves in the past to the use of tar as a joint filler for repressed brick, and have insisted that the joints be poured full. But I have noticed that although we start pouring at the curb and work toward the center of the pavement in order to give the tar a chance to chill and hold back the hot material from the curb, when the pouring is done on

a very hot day the tar will get down into the gutters. Going over the joint a second time we find after the tar has chilled it has gone down to a level of ½ to ⅝ in. below the brick.

"We have observed as well that after the pavement has gone through a hot summer and a cold winter, the tar will be found from ¼ to ½ in. below the surface of the brick, and that the edges of the brick begin to peel off and go to pieces at the joints. This, to my mind, is a very serious objection to the use of tar filler, and to eliminate this we have decided to use asphalt this year to see if this defect cannot be overcome.

"We try to pour the asphalt in such a manner that the joints will be filled flush the first time, and then go over the joints a second time to fill up the places missed on the first pouring. This I believe, with the help of close inspection, and a reasonable amount of care in pouring, will result in our getting well filled joints and thus prevent chipping of the edges of the brick.

"Our reason for considering asphalt preferable to tar is based on an experience we had last year on a street having cement-grouted joints. On this street three joints parallel to the curb and three joints every 30 ft. lengthwise of the pavement were provided as expansion joints. I have paid particular attention to these joints, and the asphalt is where it was when first put in, and as yet no cracks or checks can be noticed, nor have the bricks gone to pieces at the expansion joints.

"In pouring joints we start about 18 in. from the gutter and pour toward the center of the pavement, thus providing for the excess bitumen to fill up the 18 in. and the gutter joints and give it a chance to cool and hold back to a certain extent the hot material on the street crown. After the first pouring we go over the joints a second time to fill all the low places. The pavement is then covered with about ¼ in. of granulated slag, which works down into the joints and gives stability to the filler."

The specifications for asphalt filler provide that: (a) It shall contain not less than 98% of pure bitumen soluble in carbon disulphide; (b) of the total amount soluble in carbon disulphide 98½% shall be soluble in carbon tetrachloride; (c) when tested by the Dow method for one minute with a No. 2 needle weighted with 200 grams at 32° F., it shall have a penetration greater than 25; (d) when tested for five seconds with a No. 2 needle weighted with 50 grams at 115° F., it shall have a penetration not greater than 110; (e) when tested for five seconds with a No. 2 needle weighted with 100 grams at 77° F., it shall have a penetration between the limits of 25 and 60; (f) one-half gram of the material when made into a ball shall not melt or drip from an aperture one millimeter in diameter at less than 200° Fahrenheit.

Rapid Stadia Surveys Cover 50,000 Acres

Five-Man Parties Take Topography of Flood-Control Basin—Costs Compared with Other Surveys

By L. R. Howson
Principal Assistant Engineer, Alvord & Burdick, Chicago

PLANNING the flood-control system for the protection of Columbus, Ohio, necessitated the survey of an area of 50,000 acres for three reservoir sites of respectively 23,000, 18,000 and 9000 acres. This work is for the Franklin County Conservancy District, of which Alvord & Burdick, of Chicago, are the engineers. It was necessary that the survey information should be available for office computations as soon as possible, and that the surveys should be completed before winter. The stadia method was selected as combining speed with accuracy for the class of survey to be made. The methods of procedure, with instructions to parties and a system of reports for comparing the progress of the three parties, were devised by the writer. The survey was in charge of John C. Prior, resident engineer for the district.

The areas surveyed differ greatly in shape, steepness of slopes, percentage of wooded area and regularity of width or freedom from side ravines. The Delaware basin is the largest and has the most favorable topography for rapid stadia work. The survey covered 23,000 acres on a site about 14 miles long and from ½ to 2½ miles wide. The maximum difference in elevation is about 90 ft. There are only three large side ravines or creek channels.

The Dublin-basin survey covered 18,000 acres, of which about 20% is wooded. The area is 25 miles long, with an average width of about one mile and a maximum of about 2½ miles. The country is somewhat rougher than that in the Delaware basin, and has a range of 150 ft. in elevation. More numerous side ravines, some of which are virtually gorges, cut into the stratified limestone to depths of from 50 to 75 ft., with a scarcely greater width.

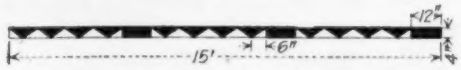
The Flint basin, though containing only about 9000 acres, has very rough topography and is largely wooded. Steep side ravines enter the river channel at frequent intervals, one every 600 ft. on each side of the river not being unusual. The basin is about 11 x 1½ miles.

Each party consisted of four field men and one office man, with salaries as follows: Chief of party, $115 to $125 per month; instrumentman, $75 to $85; draftsman (office), $85; two rodmen, $2 per day. All expenses were paid for the first three men. The rodmen received all expenses when away from home, which averaged about half the time. The work of the instrumentman and the draftsman was considered of equal importance. Rodmen were picked up locally, being selected for willingness, agility and physique. A bright country boy under a good chief or instrumentman soon becomes a

first-class stadia rodman. For each party there was a Ford automobile with special body.

About nine hours per day were spent in the field. Primary traverse lines for several days' topography were run and closed before topography was started in that area. Primary traverse points were marked with oak stakes, and levels were taken on them. Secondary traverses were run as topography was taken. All these were closed in each night, so as to catch any errors. Two field books were used. The primary traverse line was carried in both books. The draftsman each day plotted the notes taken in the field on the preceding day. Bench marks were established at about ½-mile intervals. All available data were gathered as to adequacy of bridge and culvert openings.

Special rods were made to permit of rapid long-distance reading without eye-strain. The rods were of



STADIA ROD FOR 3000-FT. SHOTS

1 x 4-in. clear poplar, 15 ft. long, painted in black and white, as shown. This rod can be read, using a half interval, for 3000 ft. as easily as the ordinary rod at only a fraction of that distance.

The instrumentman recorded his own notes. For the country surveyed a recorder's services were not warranted. For each set-up only about 15 shots could be taken.

The draftsman reduced all stadia notes with the aid of a K. & E. stadia computer. The notes were plotted with the use of an 8-in. full-circle paper protractor, which carried a scale. Both the elevation of the ground and the instrumentman's shot number were marked on the drawing for identification by the instrumentman in his daily checking of the map. The scale was 1 in. to 400 ft. for the Delaware and Flint maps, and 1 in. to 600 ft. for the Dublin map.

Each chief-of-party made a daily report on a post-card blank form. This gave the weather conditions, hours spent in the field, number of transit set-ups, number of readings taken and number of acres covered, with notes or remarks. These were compiled into weekly reports, as shown. Copies of these weekly reports were given to each party. While the figures therein were interpreted in the light of the conditions influencing them, they created an added impetus to make a good showing.

WEEK ENDING OCTOBER 23, 1915

Weather	No. Hours in Field	No. Transit Set-ups	No. Stadia Readings	Acres Surveyed	Unit Cost Field Work	Unit Cost Including Map	Av. Cost to Date
Dublin Reservoir							
Monday.... Rain	8½	16	216	250	.....	.....	.....
Tuesday.... Fair	9½	14	98	50	.....	.....	.....
Wednesday.. Fog and Fair	8½	18	108	50	.....	.....	.....
Thursday.... Fair	9½	13	160	200	.....	.....	.....
Friday..... Fair	10	14	220	250	.....	.....	.....
Saturday.... Fair	10	17	153	220	.....	.....	.....
Total.....	56	92	955	1,020	$0.093	$0.126	$0.16
				10,190 to date			
Delaware Reservoir:							
Monday.... Rain 3 hrs.	10	8	229	275	.....	.....	.....
Tuesday..... Fair	10	6	338	350	.....	.....	.....
Wednesday... Fog	10	9	190	420	.....	.....	.....
Thursday.... Fair	10	6	336	275	.....	.....	.....
Friday..... Fair	10	7	314	250	.....	.....	.....
Saturday.... Fair	10	7	258	350	.....	.....	.....
Total.....	60	43	1,665	1,620	$0.058	$0.074	$0.09
				11,975 to date			
Flint Reservoir:							
Monday.... Rain	7	10	99	70	.....	.....	.....
Tuesday.... Cloudy	10	10	74	140	.....	.....	.....
Wednesday... Fair	10	15	205	160	.....	.....	.....
Thursday.... Fair	11	12	115	70	.....	.....	.....
Friday..... Fair	10	16	229	200	.....	.....	.....
Saturday.... Fair	10	19	250	200	.....	.....	.....
Total ...	58	82	972	840	$0.100	$0.134	$0.24
				3,428 to date			

REMARKS—Dublin Delayed 2½ hrs. rain and fog. 6.7 mi Secondary Traverse Delaware. Delayed 3 hrs fog; 10.2 mi. Secondary Traverse Flint Delayed 3 hrs. rain, 8 mi Secondary Traverse

THESE WEEKLY REPORTS SENT TO EACH PARTY

The form of the report was so arranged as to indicate the differences in the character of the topography of the three areas, which has been noted above. It is evident that where few shots per acre are taken, the topography is comparatively uniform. Where few shots per set-up are possible, the country is either wooded or rough.

The greatest area covered in any one week was 2190 acres. The greatest number of shots in any week was 1902, or an average of 317 per day. The average number of shots per day for all parties was slightly over 200, counting all time occupied in running level and traverse lines.

Comparative Costs of Surveys

The small table shows the summarized performance and costs of the three survey parties on this work. The larger table has been prepared to show the costs of these and other stadia surveys where some details of execution, cost and character of land surveyed were available.

TABLE I. STADIA SURVEYS OF RESERVOIR AREAS AT COLUMBUS, OHIO

	Dublin	Delaware	Flint
Total acres surveyed	18,000	23,000	9,000
Av. acres surveyed per day	182	274	105
Av. hours in field per day *	9.1	9.5	9.1
Transit set-ups per day	11	6½	8½
Shots per set-up	13.1	48.5	17.8
Shots per acre	0.78	1.19	1.44
Shots per hour	15.8	34.5	16.8
Cost, field work per acre	8.5c.	6.35c.	12.95c.
Cost, map work per acre	2.3c.	1.72c.	4.40c.
Total cost, field and map work per acre	10.8c.	8.07c.	17.35c.

* No deductions for inclement weather.

TABLE II. COST OF TOPOGRAPHIC SURVEYS MADE BY STADIA

Location	Acres Surveyed	No. in Field Party	Purpose of Survey	Contour Interval Ft.	Av. Acres per Day	Av. Shots per Day	Cost per Acre: Field Work, Cents	Cost per Acre: Total Including Map, Cents	Remarks
St. Louis	15,000	7	.....	3	60.6	300	40.7	82.5	.....
Connellsville, Pa.	107,500	..	Coal areas	10	...	...	6½	18.1	
Sunnyside, Wash.	83,610	3 to 5	Irrigation	1	...	...	16	27.6	Land partly developed by orchard and canals, partly sage brush
Riverside, Cal.	7,450	5	Industrial dev.	2	74½	550	22	29.8	Rolling, cultivated, 300 ft. range in elevation
Iron Mountain, Mich.	1,080	3	Sewer design	2	77	170	14.3	.....	Rolling, no trees
Salmon River, N. Y.	9,600	6-8	Reservoir sites	10	205	82	10	12½	Rough country about one-third wooded; maps to scale of 400 to 800 ft. per inch
Fish Creek, N. Y.	12,150	6-8	Reservoir sites	5	288	268	8½	12½	
Black River, N. Y.	54,300	6-8	Reservoir sites	10	1,160	239	2.6	3.6	
Columbus, Ohio	.....	...	.....	...	...	...	...	...	.....
Dublin Res.	18,000	4	Reservoir sites	5	200	143	8.5	10.8	.....
Delaware Res.	23,000	4	Reservoir sites	5	250	328	6.35	8.07	.....
Flint Res.	9,000	4	Reservoir sites	5	100	153	12.95	17.35	.....

Would Close Milwaukee River to Navigation

Engineers' Society Recommends Port Occupation by Longitudinal Viaducts, and Retention of Barge Traffic

CLOSING the upper part of the Milwaukee River to navigation, and utilizing it as a thoroughfare by building a viaduct along each side (over the water) are the radical recommendations in a report made recently by the Engineers' Society of Milwaukee. The river would be closed above the present bridge at Michigan and Sycamore Sts. The report has been submitted to the city council, and if the conclusions are approved the city will then have to submit the proposition to the U. S. War Department. In June, 1916, the mayor of Milwaukee requested the society to investigate the cost of building bascule bridges, and of maintaining the present drawbridges over the Milwaukee River, in order to see whether these costs in comparison with those for fixed bridges would justify the movement for closing the river. The committee to which this matter was referred did not confine its investigations to the bridges, but included also the use of the river for navigation and the best method of improvement for the city.

The present conditions may be summarized briefly. The river is narrow and winding so that it cannot be used by the largest lake vessels of the modern type, and there are few places where large boats can pass. Boats of more than 5000 tons capacity cannot navigate the river, while only about 7.6% of the coal tonnage of the city is received in boats up to this capacity. Only about 37% of the waterfront is utilized for dockage, and most of the docks are dilapidated.

Most of the nine drawbridges are old, narrow and too light for present loads. The street traffic is growing steadily and is hampered by the old narrow bridges, so that new structures will soon be required. The annual cost for maintenance, operation, interest and depreciation of bridges is about $85,000. Dredging for navigation purposes in the channel above the point where closure is proposed costs from $3550 to $7500 per year. The bridge and dredging expenses together represent an annual cost to the city of about 16.2c. per ton of original shipments, or 12.2c. per ton including reshipments and ashes.

This part of the river, states the report, is now a poor business utility. Commercial and civic conditions would not warrant the great expense necessary in order to adapt it to modern vessels by straightening, widening and deepening the channel and building new bridges of greater span. To do this would also result in splitting the busiest part of the city into two parts, connected only by drawbridges which would be opened frequently.

Furthermore, the city has excellent opportunities for harbor development near the mouth of the river (both within the river and on the lake front). These would be readily accessible by the largest lake boats, and would have good railway communication. These harbor projects are already under consideration, and with such facilities in use the traffic on the upper part of the Milwaukee River would doubtless be reduced.

With the channel closed to lake vessels, and crossed by fixed bridges, the principal benefit would be the elimination of traffic interruptions. The committee's plans, however, provide for greatly improved traffic facilities by the construction of roadways or viaducts on each side of the river and inside of the present dock lines. Between them would be an open channel about

VIADUCTS ALONG THE MILWAUKEE RIVER PROPOSED AS NEW TRAFFIC FACILITIES

75 ft. wide. Tentative plans calls for structures with a 30-ft. roadway and two 10-ft. sidewalks, supported on columns, so that there would be practically no restriction or interruption of the channel.

Such thoroughfares would relieve traffic congestion and provide new outlets for the business district. The abutting property would be benefited also by the additional street frontage. The cost of these viaducts, built of concrete, is estimated at $125 per foot. The river channel would be available for barges. Fire protection of the riverfront district could be provided by low-deck fireboats having gasoline or oil engines, or by a pumping station on the river to serve all the city's downtown high-pressure fire-protection lines.

With the river kept open for lake traffic, the cost of necessary new bridges would be about $1,484,220. The annual cost would be about $165,169 for operation, maintenance, interest and depreciation. The improvements proposed along the river when closed to traffic would cost $3,375,625. From this there would be deductions of $130,000 for salvage on the bascule bridges removed, and $2,555,000 for assessments, leaving a net cost of $690,625. The annual cost (including damages) would be about $145,448.

The conclusion arrived at by the committee is that the closing of the Milwaukee River above the Michigan-Sycamore St. bridge is feasible and desirable. It recommends that the city authorities should seek the coöperation of civic societies, the harbor commission and other bodies interested, in studying the proposition more deeply, and in determining the character of the improvements to be made. After such a conference the city would be in a position to submit the project to the consideration of the federal government.

Method of Closing Break in Dam Planned by Ralph D. Thomas

The article, "Break in Dam Closed Rapidly at Brainerd, Minn.," published in *Engineering News-Record*, Aug. 16, page 313, credited the C. L. Pillsbury Co., of Minneapolis, with participation in this work. As a matter of fact, this company was not connected with the work in any way. Ralph D. Thomas, civil and hydraulic engineer, of Minneapolis, was solely responsible for the method of closure, which was executed under the direction of N. F. Helmers.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Have Tests Been Made on Concrete Using Calcined Sand?

Sir—I would like to hear of any comparative tests on cement mortars using sand dried at about 100° C. and with sand calcined at a red heat.

While such treatment of sand would of course not be commercially profitable, yet this question has arisen: Does mixing cement with dried or calcined sand effect a better mix if mixed dry and then with water? How does the strength of such concrete compare with that made with air-dried or moist sand?

ARMIN C. AREND,
Chemist, Glass Brick Co.

Huntington, W. Va.

In Support of Wooden Ships

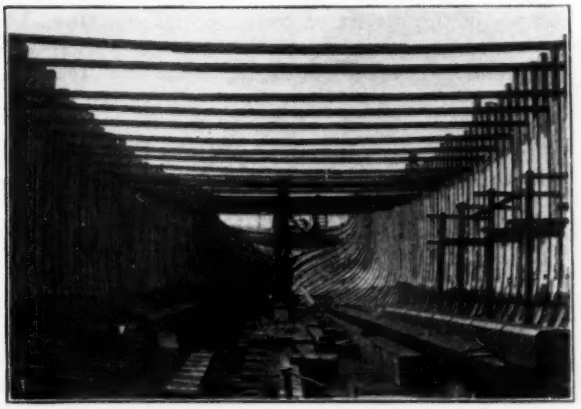
Sir—I have read with considerable interest your discussion on p. 51 of the July 12 issue of the *Engineering News-Record*, entitled "What Is Delaying the Fabricated-Steel Ships?" I think the reader is very apt to get the impression from this article that you are condemning, in general terms, the wooden ship. This I do not believe to be your intention, but more to condemn the type which was advocated by Mr. Denman, and which design was against the good judgment of General Goethals.

If your condemnation is wholesale in regard to the wooden ship, past records do not support your contention. Many wooden ships are now being built by commercial interests to carry over-seas cargo, and unless they felt confidence in wooden ships they would not be willing to spend large sums of money in the construction of this kind of carrier. This is true of many companies on the Pacific Coast at the present time. In fact, all the wooden ships are being constructed that it is possible to build, aside from those now under contract by the United States Government.

One of the points which I consider to be favorable to wooden ships is that unquestionably many of these ships under construction will be sunk, and if a wooden ship goes down, the loss is much less than in the case of a steel ship. It is also true that the cargo destroyed by the sinking of a wooden ship will be smaller in amount than through the sinking of the type of steel ship now building. This will mean a greater expenditure of torpedoes in order to account for any great amount of tonnage.

The experience on the Pacific Coast would hardly indicate that wooden ships, well built, would be of little value after five years, as you state. We have many ships in service which have been active twelve to twenty years and they are still giving good service. There seems no logical reason why a wooden ship cannot be stiffened by vertical and horizontal steel trusses so as to be sufficiently rigid to withstand the hardest usage on the high seas. This combination type of ship, I predict, will form a standard type of cargo carrier which will compete commercially with the best design all-steel ship built.

As far as the durability of wooden ships is concerned, if they are properly constructed, there is no need for trouble due to dry rot, nor should they rack in continued service on the high seas. Therefore, a wooden ship, properly constructed, would prove a good investment, and should not be condemned as worthless after five years' service.



THIS TYPE OF WOODEN SHIP SAID TO HAVE PROVED SUCCESSFUL

I am inclosing a photograph of a wooden ship similar to those building on this coast. There have been many constructed of this general type, and as previously stated they have given an excellent account of themselves in service.

O. P. M. GOSS,
Consulting Engineer, West Coast Lumbermen's Association.

Seattle.

Engineers' Lack of Business Sense Blamed on the Schools

Sir—Referring to the editorial in your issue of Aug. 30 last, "Professional Questions Call for Study," I note the statement "Some engineers do starve, or nearly so, by adhering to the old principles. That is a loss to the nation, since their less conservative brethern are often, also, less able; only in business acumen do they excel."

It is the writer's observation that the most universal criticism of the engineering profession is that engineers lack business sense and judgment. There are, of course, many notable exceptions. I believe it is true that for the most part the leading men in the profession are men with sound business ideas. It is reasonable that the engineer who can best serve his clients, if they are running or starting a business venture of any kind especially, is the one who understands all sides of the problem to be solved. In the majority of instances this requires business knowledge and judgment. Personally I believe that the failure of the profession as a whole in this respect has been one of the main reasons why engineers as a class do not rank higher in the affairs of the world and in social position. I also believe that "poor compensation," so often complained of by engineers, is due largely to this same lack of business ability.

The cause of this general lack of business ideas and knowledge, can, I believe, be traced to the system of education in our universities and colleges for men who are to follow the engineering profession, at least to a large extent. As has been frequently said before an engineering course as usually given has the tendency to narrow a man's vision, whereas breadth of vision and keen foresight are very necessary to the success of a man in business, and to the understanding of business.

Some improvement has been made in engineering courses in the matter of more general education, but the writer believes there is still much room for improvement, and he hopes to see the day come when the engineering profession will merit and achieve the position its importance in the affairs of the world ought to bring.

WALTER H. WHEELER.

Minneapolis, Minn.

Bituminous Foundations for Sheet-Asphalt Surfaces

Sir—Relative to Lester Kirschbraun's paper "Bituminous Foundations for Sheet-Asphalt Surfaces," (*Engineering News-Record*, June 21, 1917, p. 591):

You printed, on Aug. 23 a letter from Geo. B. McGrath, general manager, Southern Purchasing Co., Chattanooga, Tenn., and on Aug. 30, a letter from L. B. West of the West Construction Co., of the same city, both of which letters referred to Mr. Kirschbraun's paper, and my letter commenting on the same, which you published July 26.

The intent of my previous letter was to attempt to draw both engineers and contractors into discussing Mr. Kirschbraun's ideas, which, as I stated, I support in the main. It is apparent that I was mildly successful.

I am, indeed, glad to learn of the activity of certain paving contractors in the South in advancing arguments. It is my opinion that every engineer, worthy of the name, would welcome any logical, well meant data along the line of progress in this or any other field, even though it happened to be promulgated by a "modest" contractor (to quote Mr. McGrath)—providing, of course, such propaganda answered the question in a real, practical sense, and did not merely advance ideas, which if adopted would be advantageous to the contractor only. In short, engineers generally are ready and willing to be "educated" by contractors or anyone else who has any revealing light to cast.

It is quite evident that some contractors have given this subject serious consideration, as is evidenced by the replies. However, I wonder whether these ideas would have been so ably revealed, had it not been for what Mr. McGrath termed the writer's "chiding" tone.

When men like Mr. West come forward with such a letter, it is possible for us all to obtain the contractor's practical ideas, as he sees them, presented in such a manner that there can be no misunderstanding them. There can be no doubt about such arguments not having their effect on the ultimate solution of this problem, which we all must realize is one requiring sober consideration from every angle—the contractor's included.

If bituminous foundations are to be generally used for asphaltic surfaces, a great deal of "educating" must be done in another direction, namely, that of the contractor. To prove successful, this type of foundation must be laid under ideal conditions upon a sub-grade which has been prepared with extreme care, and properly protected during the lapse of time after its preparation and before the foundation is laid.

We have some first-class contractors in the Chicago district (the writer, for one, has learned a great deal from some of them, too), but I regret to say that I have met very few, if any, who are inclined to give proper attention to the preparation of a sub-grade without being literally forced into doing so. I have seen concrete base laid (not in Oak Park, I assure you) on a sub-grade which, owing to recent rains and traffic, was in such abominable condition that it was a crime to continue with the work. Yet the contractor was blithely "sloshing" about in the mud, laying concrete.

Both Mr. McGrath and Mr. West indirectly allude to that old time atmosphere indicative of friction between engineer and contractor. I believe that spirit is rapidly dying out for the simple reason that broad-minded men will not support it.

There are still some of those engineers to whom Mr. West refers, just as there are some contractors of the type I mention. Perhaps that is sufficient reason why some engineers have refused to consider ideas suggested by contractors. Engineers, generally speaking, are primarily interested in safeguarding the public, or the tax-payer. Consequently they have been extremely slow in putting to practice ideas advanced by those whom they have had to fight in fulfilling their duty to the public. Both of these types are steadily becoming scarce, and decidedly better relations exist between contractor and engineer—it pays better on both sides.

Mr. McGrath refers to a letter by S. H. Lea, city engineer of Charlotte, N. C. (*Engineering News-Record*, July 12, p. 83) which states as an argument for cement-concrete foundations, their ability to bridge soft spots in sub-base. If Mr. McGrath will help engineers "educate" his "brethren" to follow his suggestion in regard to proper attention to these weak spots, then Mr. Lea's argument for cement concrete will become unworthy of consideration.

H. W. SKIDMORE,
Construction Engineer, Department of Public Works.

Oak Park, Ill.

Sir—The paper "Bituminous Foundations for Sheet-Asphalt Surfaces" by L. Kirschbraun, on p. 591, issue of June 21, seems to have received a hearty and deserving welcome by various engineers and contractors as reflected in various letters in the columns of *Engineering News-Record*

There are several good points to be enumerated in favor of this type of construction; these having been ably set forth by Kirschbraun. He goes on further to say, however, that, "besides the fact that there are certain practical considerations of construction which favor the use of a bituminous-concrete foundation whenever conditions permit, so far as cost is concerned a bituminous-concrete foundation is more economical under present price levels."

Let us consider each item of cost as given in his article. "The 5-in. bituminous base requires from 22 to 25 lb. of asphalt cement per square yard, which would cost about 20 to 25c. A square yard of 1:3:6 port-

land-cement concrete of the same thickness requires about 53 lb. of cement." There therefore appears to be a saving of about 10c. per square yard on cementing material, if cement costs $2.50 per barrel.

"Stone and sand for either construction will cost the same, and the expense of hauling bituminous mixture from the plant to the street will be ordinarily counterbalanced by the expense of hauling from the cars to the street, the individual elements going into the portland-cement concrete. That the labor of mixing and placing bituminous concrete will be less than for portland-cement concrete will be apparent when one considers the facilties at the asphalt plant for mechanically handling the constituents in large quantities. The fuel cost of heating the aggregate for bituminous concrete must, however, be considered." The saving in the "labor of mixing and placing" the bituminous concrete would seem rather doubtful especially for the railroad type of plant in common use. Further it would seem that the cost of heating the aggregate would more than balance any saving in the "labor of mixing and placing" even for the very best stationary plants.

"A detail which substantially reduces the cost of construction on a bituminous foundation is the fact that it will be unnecessary to employ a binder course, the foundation itself acting in that capacity. For a binder course of 1½ in. this saving amounts to about 25c. per sq.yd. and in addition permits a saving in the cost of excavation and grading. In many cases, however, this saving will be counterbalanced by the cost of providing drainage or the necessity of placing broken stone or cinders upon the subgrade." Assuming that the figures given above are correct it would appear that the 5-in. foundation of bituminous concrete should cost 83.4c. per square yard which would not be an unreasonable price for one square yard of 5-in. concrete with 1½-in. binder even at present prices. If the 1½ in. of binder costs 25c. per sq.yd., the 5-in. foundation would cost 83.4c. per sq.yd. because it would be necessary to lay it in at least two courses in order to get reasonably uniform compaction on the earth foundation.

"To the paving contractor it will certainly be an advantage to dispense with the extra equipment for mixing portland-cement concrete and to use instead the same equipment that must be brought to the job for the surface. In addition, in times of labor scarcity it is a decided advantage to do away with the extra organization required for the portland-cement concrete, inasmuch as bituminous concrete, both in preparation and laying, will be handled by the same men who handle the surface. It will be possible also to finish the pavement construction immediately following the grading, as bituminous concrete will require no long period of time to set, but can be topped almost at once. As this affects the efficiency of the organization and the speed of handling work it will amount to no small item to the paving contractor." While it is true that the size of a paving organization can be reduced by doing away with the cement concrete gang the amount of work completed per day will be more than correspondingly reduced. An asphalt plant that mixes 1000 sq.yd. of 1½-in. binder during the morning hours, prepared to be topped in the afternoon, will be able to mix only 300 sq.yd. of the 5-in. bituminous concrete base in the same time. The plant that would mix 1000 sq.yd. of finished pavement (1½-in. binder, 1½-in. top) per day would mix only about 460 sq.yd. of finished bituminous foundation pavement. Two asphalt plants could not complete as much as the concrete mixer and single asphalt plant. The reduction in equipment and men is not apparent.

While there are good points to be made in favor of a bituminous-concrete foundation for sheet asphalt it seems that economy in first cost is not one of them. Even though the original cost will be greater for this type of construction it seems well worth trying. Engineers and contractors will watch with interest any experiments with this type of foundation.

ROY M. GREEN,
Assistant Professor of Highway Engineering,
Agricultural and Mechanical College of Texas.
College Station, Tex.

Fire Destroys Old Landmark

Sir—Accompanying is a photo of the remains of the Fincks Basin suspension bridge spanning the Mohawk River at Little Falls, N. Y. This historic span

BURNING OF TOWER LETS SUSPENSION BRIDGE DROP INTO RIVER

was destroyed recently by a fire in the north tower. The bridge was erected in 1869-70 at a cost of about $22,000.

ARTHUR T. CLARK,
Resident Engineer, Water-Supply Department,
Herkimer, N. Y. Municipal Commission.

Filtration and Hypochlorite at Niagara Falls

Sir—In my article entitled "Filtration Controls Typhoid at Niagara Falls," published on p. 440 of your issue of Sept. 6, I stated that one of the two plants supplying the city, that owned by the New York Water Co., used hypochlorite as a sterilizing agent in connection with filtration. I am advised that this statement is in error, in that the plant is using liquid chlorine instead of hypochlorite. My informant states that the pioneer experiments on the use of liquid chlorine were made at this plant, and that liquid chlorine has been continuously used at the plant since 1912. I am further advised that the New York Water Co. is furnishing about 40% of the water supplied to Niagara Falls at the present time. CHARLES B. BURDICK.

Chicago.

THE ENGINEER IN FIELD AND OFFICE

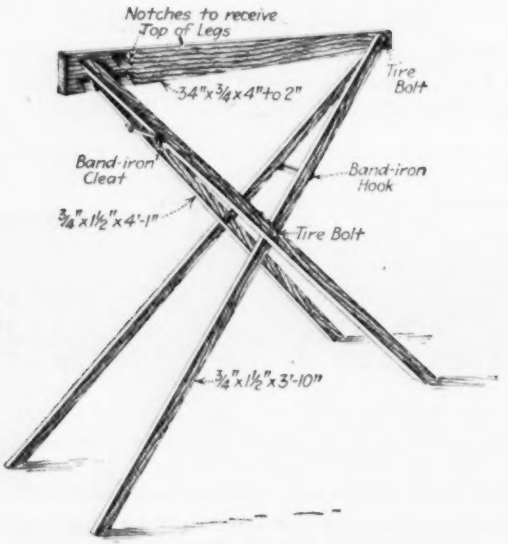
A DEPARTMENT DEVOTED TO DETAILS OF THE DAY'S WORK

Folding Drawing Trestle Is Rigid and Simple to Construct

By H. A. Sitterley

Chief Engineer, Low Moor Iron Co. of Virginia, Low Moor, Va.

A DRAWING table trestle which will take up a space only 4 in. square and 4 ft. long when stored, would prove a great convenience to many engineers who do not need a drawing table continually, or whose work sometimes requires one where ordinarily there would not be proper facilities. The construction illustrated in the accompanying drawing has been used for the past two years by the writer and has proven to be convenient,



ADJUSTMENT FOR HEIGHT AND SLOPE OF BOARD EASILY MADE

rigid, light and capable of being easily transported and stored in a small space.

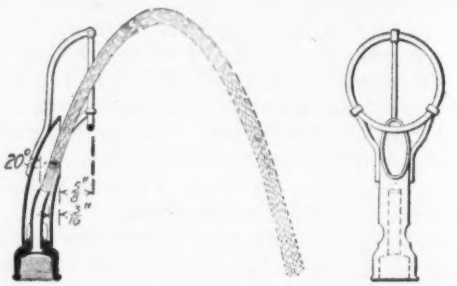
The following is a bill of necessary materials:

2—⅞ x 1½-in. hardwood strips, 4 ft. 1 in. long, front legs.
2—⅞ x 1½-in. hardwood strips, 3 ft. 10 in. long, back legs.
1—⅞ x 4-in. hardwood board, 34 in. long, top piece.
6—1-in. shothead screws.
2—2-in. tire-bolts and washers.
1—2½-in. tire-bolt and washer.
1—⅞-in. band-iron strip, 7 in. long, drilled for screws on 6-in. centers and one hole cut out to serve as a hook.
1—⅞-in. band-iron strip, 4 in. long, drilled for screws on 3½-in. centers.

The method of assembling is perhaps sufficiently illustrated in the drawing. By placing the top ends of the longer legs in the different notches, which must be gained in the top piece, the top of the trestle can be made either level or sloping, and the height adjusted from 34 in. to 42 in.

Which Type of Drinking Fountain Do You Use?

TESTS of 77 drinking fountains of 15 different types (see sketches) at the University of Minnesota showed that due to improper design all were possible sources of infection of the users. No less than 80%



THREE TESTS OF THIS PROTECTED DRINKING FOUNTAIN SHOWED NO STREPTOCOCCI INFECTION

of the fountains and the water from 11% of them contained streptococci, although none were found in the water supplied to the 18 buildings in which the fountains were located.

The infection was due to contact between the lips of users and the structure of the fountains, or to water falling back from lips to fountains, owing to vertical discharge of the jet.

To keep lips away from the fountain structure and water from falling back on it, and to prevent water from being retained in fountains with cup- or ring-shaped depressions, the fountain shown herewith was designed. Three bacterial tests showed no streptococci on either the fountain or the water discharged from it.

The study here outlined is reported in detail in a paper by H. A. Whittaker, director of the Division of Sanitation, Minnesota State Board of Health (Reprint No. 397, Public Health Reports, Washington, D.C.). George W. Putnam assisted in the investigation.

TESTS OF 77 FOUNTAINS OF ONE OF THESE 15 TYPES SHOWED 80% OF THE FOUNTAINS AND 11% OF THE WATER SAMPLES INFECTED WITH STREPTOCOCCI

Tables Give Moment Coefficients for Concentrated Loads

BY S. M. COTTEN

Waco, Texas

THE TABLES herewith give the coefficients of the moments in a beam at each of nineteen sections, varying by one-twentieth of the span, due to a concentrated load at any of these sections. It will be observed that the tables are analogous to influence lines, and are used in the same manner.

The position of the load and of the sections is expressed as a percentage of the span distant from the left support. Let P be the load and L the span. Then the moment for any condition is PL multiplied by the corresponding coefficient. The reactions for any position of the load are P times the corresponding reaction coefficient. Interpolation may be used for intermediate values of the coefficients. Inflection points are expressed as a percentage of the span distant from the support considered.

While, in general, the use of the tables is sufficiently

SIMPLY SUPPORTED BEAM

Load at Section	MOMENT COEFFICIENT-SECTION AT																			Left End Reaction	Right End Reaction
	.05	.10	.15	.20	.25	.30	.35	.40	.45	.50	.55	.60	.65	.70	.75	.80	.85	.90	.95		
.05	.047	.045	.042	.040	.037	.035	.032	.030	.027	.025	.022	.020	.017	.015	.013	.010	.007	.005	.002	.95	.05
.10	.045	.090	.085	.080	.075	.070	.065	.060	.055	.050	.045	.040	.035	.030	.025	.020	.015	.010	.005	.90	.10
.15	.042	.085	.127	.120	.112	.105	.097	.090	.082	.075	.067	.060	.052	.045	.037	.030	.022	.015	.007	.85	.15
.20	.040	.080	.120	.160	.150	.140	.130	.120	.110	.100	.090	.080	.070	.060	.050	.040	.030	.020	.010	.80	.20
.25	.037	.075	.112	.150	.187	.175	.162	.150	.137	.125	.112	.100	.087	.075	.062	.050	.037	.025	.012	.75	.25
.30	.035	.070	.105	.140	.175	.210	.195	.180	.165	.150	.135	.120	.105	.090	.075	.060	.045	.030	.015	.70	.30
.35	.032	.065	.097	.130	.162	.195	.227	.210	.192	.175	.157	.140	.122	.105	.087	.070	.052	.035	.017	.65	.35
.40	.030	.060	.090	.120	.150	.180	.210	.240	.220	.200	.180	.160	.140	.120	.100	.080	.060	.040	.020	.60	.40
.45	.027	.055	.082	.110	.137	.165	.192	.220	.247	.225	.202	.180	.157	.135	.112	.090	.067	.045	.022	.55	.45
.50	.025	.050	.075	.100	.125	.150	.175	.200	.225	.250	.225	.200	.175	.150	.125	.100	.075	.050	.025	.50	.50
.55	.022	.045	.067	.090	.112	.135	.157	.180	.202	.225	.247	.220	.192	.165	.137	.110	.082	.055	.027	.45	.55
.60	.020	.040	.060	.080	.100	.120	.140	.160	.180	.200	.220	.240	.210	.180	.150	.120	.090	.060	.030	.40	.60
.65	.017	.035	.052	.070	.087	.105	.122	.140	.157	.175	.192	.210	.227	.195	.162	.130	.097	.065	.032	.35	.65
.70	.015	.030	.045	.060	.075	.090	.105	.120	.135	.150	.165	.180	.195	.210	.175	.140	.105	.070	.035	.30	.70
.75	.012	.025	.037	.050	.062	.075	.087	.100	.112	.125	.137	.150	.162	.175	.187	.150	.112	.075	.037	.25	.75
.80	.010	.020	.030	.040	.050	.060	.070	.080	.090	.100	.110	.120	.130	.140	.150	.160	.120	.080	.040	.20	.80
.85	.007	.015	.022	.030	.037	.045	.052	.060	.067	.075	.082	.090	.097	.105	.112	.120	.127	.085	.042	.15	.85
.90	.005	.010	.015	.020	.025	.030	.035	.040	.045	.050	.055	.060	.065	.070	.075	.080	.085	.090	.045	.10	.90
.95	.002	.005	.007	.010	.013	.015	.017	.020	.022	.025	.027	.030	.032	.035	.037	.040	.042	.045	.047	.05	.95

BEAM FIXED AT RIGHT END

Load at Section	MOMENT COEFFICIENT – SECTION AT (To left of heavy broken line – positive moments; to right – negative.)																			Left End Reaction	Right End Reaction	Inflection Point
	.05	.10	.15	.20	.25	.30	.35	.40	.45	.50	.55	.60	.65	.70	.75	.80	.85	.90	.95	1.00			
.05	.046	.042	.039	.035	.031	.027	.024	.020	.016	.012	.009	.005	.001	.002	.006	.010	.014	.017	.021	.025	.925	.075	.333
.10	.042	.085	.078	.070	.063	.055	.048	.040	.033	.025	.018	.010	.003	.005	.012	.020	.027	.034	.042	.049	.851	.149	.331
.15	.039	.078	.116	.105	.094	.083	.072	.061	.050	.038	.027	.016	.005	.007	.018	.030	.041	.054	.066	.073	.777	.223	.328
.20	.035	.070	.106	.141	.126	.111	.096	.082	.067	.052	.037	.023	.008	.007	.022	.037	.051	.066	.081	.098	.704	.296	.324
.25	.032	.063	.095	.127	.158	.140	.122	.103	.085	.066	.048	.030	.011	.007	.025	.044	.062	.081	.099	.117	.633	.367	.319
.30	.028	.056	.085	.113	.141	.169	.147	.125	.103	.082	.060	.038	.016	.006	.027	.049	.071	.093	.114	.136	.564	.436	.313
.35	.025	.050	.075	.099	.124	.149	.174	.148	.123	.096	.073	.048	.025	.002	.028	.053	.078	.103	.128	.153	.497	.503	.305
.40	.022	.043	.065	.086	.108	.129	.151	.173	.144	.116	.087	.059	.031	.002	.026	.054	.083	.111	.140	.168	.432	.568	.296
.45	.018	.037	.055	.074	.092	.111	.129	.148	.167	.135	.104	.072	.041	.009	.020	.053	.085	.116	.148	.179	.371	.629	.285
.50	.016	.031	.047	.063	.078	.094	.109	.125	.141	.156	.122	.087	.053	.019	.016	.050	.084	.119	.153	.187	.313	.687	.273
.55	.013	.026	.039	.052	.065	.077	.090	.103	.116	.129	.142	.105	.068	.031	.006	.043	.080	.118	.155	.192	.258	.742	.258
.60	.010	.021	.031	.042	.052	.062	.073	.083	.094	.104	.114	.125	.085	.045	.006	.034	.074	.113	.152	.192	.208	.792	.243
.65	.008	.016	.024	.033	.041	.049	.057	.065	.073	.082	.090	.098	.106	.064	.022	.020	.062	.104	.146	.188	.162	.838	.228
.70	.006	.012	.018	.024	.030	.036	.042	.049	.055	.061	.067	.073	.079	.085	.041	.003	.047	.090	.135	.178	.122	.878	.203
.75	.004	.009	.013	.017	.021	.026	.030	.034	.039	.043	.047	.052	.056	.060	.064	.019	.027	.072	.118	.164	.086	.914	.179
.80	.003	.006	.008	.011	.014	.017	.020	.022	.025	.028	.031	.034	.036	.039	.042	.045	.003	.050	.097	.144	.056	.944	.153
.85	.002	.003	.005	.006	.008	.010	.011	.013	.014	.016	.018	.019	.021	.022	.024	.026	.027	.021	.070	.118	.032	.968	.122
.90	.001	.001	.002	.003	.004	.004	.005	.006	.006	.007	.008	.009	.009	.010	.011	.012	.012	.013	.036	.085	.015	.985	.087
.95	.000	.000	.001	.001	.001	.001	.001	.001	.002	.002	.002	.002	.002	.003	.003	.003	.003	.003	.003	.046	.004	.996	.046

BEAM FIXED AT BOTH ENDS

Load at Section	MOMENT COEFFICIENT – SECTION AT (Outside heavy broken lines – negative moments; inside – positive.)																				Left End Reaction	Right End Reaction	Left Infl. Pt.	Right Infl. Pt.
	0	.05	.10	.15	.20	.25	.30	.35	.40	.45	.50	.55	.60	.65	.70	.75	.80	.85	.90	.95	1.00				
.05	.045	.004	.004	.004	.003	.003	.003	.002	.002	.002	.001	.001	.000	.000	.000	.001	.001	.001	.002	.002	.002	.993	.007	.045	.333
.10	.081	.032	.016	.015	.013	.012	.011	.009	.008	.006	.005	.004	.002	.001	.001	.002	.003	.005	.006	.007	.009	.972	.028	.083	.321
.15	.108	.061	.014	.032	.029	.026	.023	.020	.017	.014	.011	.008	.005	.002	.001	.004	.007	.010	.013	.016	.019	.940	.061	.115	.315
.20	.128	.083	.038	.006	.051	.046	.041	.036	.030	.025	.020	.015	.010	.004	.001	.006	.011	.016	.022	.027	.032	.896	.104	.143	.308
.25	.141	.098	.056	.013	.028	.070	.063	.055	.047	.039	.031	.023	.016	.008	.000	.008	.016	.023	.031	.039	.047	.845	.156	.166	.300
.30	.147	.108	.069	.030	.009	.049	.088	.077	.066	.056	.045	.034	.023	.013	.002	.009	.020	.031	.041	.052	.063	.784	.216	.188	.292
.35	.148	.112	.076	.040	.004	.032	.068	.103	.090	.075	.061	.047	.033	.019	.005	.009	.023	.037	.051	.066	.080	.718	.282	.206	.282
.40	.144	.111	.079	.047	.014	.018	.050	.083	.115	.098	.080	.063	.045	.027	.010	.008	.025	.043	.061	.078	.096	.648	.352	.222	.272
.45	.136	.107	.079	.050	.021	.007	.036	.065	.094	.122	.101	.080	.059	.037	.016	.005	.026	.048	.069	.090	.111	.575	.425	.237	.262
.50	.125	.100	.075	.050	.025	.000	.025	.050	.075	.100	.125	.100	.075	.050	.025	.000	.025	.050	.075	.100	.125	.500	.500	.250	.250
.55	.111	.090	.069	.048	.026	.005	.016	.037	.059	.080	.101	.122	.094	.065	.036	.007	.021	.050	.079	.107	.136	.425	.575	.262	.237
.60	.096	.078	.061	.043	.025	.008	.010	.027	.045	.063	.080	.098	.115	.083	.050	.018	.014	.047	.079	.111	.144	.352	.648	.272	.222
.65	.080	.066	.051	.037	.023	.009	.005	.019	.033	.047	.061	.075	.090	.103	.068	.032	.004	.040	.076	.112	.148	.282	.718	.282	.206
.70	.063	.052	.041	.031	.020	.009	.002	.013	.023	.034	.045	.056	.066	.077	.088	.049	.009	.030	.069	.108	.147	.216	.784	.292	.188
.75	.047	.039	.031	.023	.016	.008	.000	.008	.016	.023	.031	.039	.047	.055	.063	.070	.028	.013	.056	.098	.141	.156	.845	.300	.166
.80	.032	.027	.022	.016	.011	.006	.001	.004	.010	.015	.020	.025	.030	.035	.041	.046	.051	.008	.038	.083	.128	.104	.896	.308	.143
.85	.019	.016	.013	.010	.007	.004	.001	.002	.005	.008	.011	.014	.017	.020	.023	.026	.029	.032	.014	.061	.108	.061	.940	.315	.115
.90	.009	.007	.006	.005	.003	.002	.001	.001	.002	.004	.005	.006	.008	.009	.011	.012	.013	.015	.016	.032	.081	.028	.972	.321	.083
.95	.002	.002	.002	.001	.001	.001	.000	.000	.000	.001	.001	.002	.002	.002	.003	.003	.003	.004	.004	.004	.045	.007	.993	.333	.045

obvious to require no explanation, the writer would suggest that their principal function is for the investigation of the effect of a series of related moving concentrations as these pass over a beam. Their application to such a condition will be apparent upon inspection.

Details of Mounting Blueprints on Muslin

By Milton Harris
Presidio Training Camp, San Francisco, Calif

MAPS and plans on paper frequently fail by tearing or wearing through due to hard usage. Sensitized cloth has been employed more or less successfully, but it has its disadvantages due to the fact that the cloth is generally of poor quality and tears easily. Furthermore, if allowed to stand for some time before being used, the sensitizing solution causes the cloth to rot. A much better and not too difficult method is to mount the paper print upon cloth. Large wall maps hang better and are much less liable to be harmed when mounted in this way than when left unmounted.

The print should be made upon "medium" weight paper unless an extra strong sheet is desired. While the printing is going on, a helper can prepare the cloth backing. Unbleached muslin that sells at about 10c. per yard is ordinarily used. Select a smooth board, larger than the size of the print to be mounted, and clean it thoroughly. A drafting board or the top of a drafting table is excellent for this purpose—provided it is not cedar, for cedar will stain the prints. Fasten the cloth on this board with 4-oz. carpet tacks spaced about 2 in. apart, and driven only partially home so that they may be easily pulled.

Tack one edge of the cloth down, stretching it smooth but not too tightly, for the paper contracts on drying-out and will crack if there is not enough "give" to the cloth. Follow around the edge of the cloth until it is completely tacked down. It should now present a smooth surface and is ready for the mount. If many prints are to be mounted it may be an advantage to set several boards, end to end, and tack the cloth over their entire length. In this manner considerable cloth can be saved.

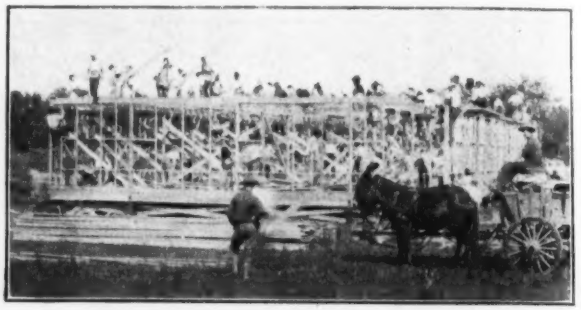
After washing the prints they should be taken from the final bath and the excess water blotted from both sides with a dry towel or cloth. If the print has been made some time previously and is dry, immerse it in water for two or three minutes—or until it is thoroughly wet—then remove it and proceed as above. Lay the print carefully down on a clean table top or board and apply a thin but even coating of paste, making sure that the edges and corners have received their share. The paste should be a fresh, stiff corn-starch paste or fresh wall-paper paste. "Kodak adhesive," a trade compound, has been found to be an excellent paste when made according to directions. Glue or library paste is unsatisfactory and should not be used.

Pick the paper up carefully and while one man holds an edge above the cloth, the other, on the opposite side of the table, should take the lowered edge and paste it down—using a stiff kalsomine or large, flat paint brush. Brush the paper down, working *away* from the body with short strokes, the helper slowly lowering his end. In this manner the brush will drive out all air bubbles and make a uniformly smooth job. After the paper is brushed fast, take a stiff clothes brush and gently pat the edges down, thus insuring a perfect contact at the vulnerable point.

The print should dry slowly in an even, moderate temperature for at least 36 hours. The print can then be trimmed. If a Van Dyke print, corrections, if any, should be applied at this time, using ordinary black drawing ink. A job completed for the County Assessor's Office at Benton County, Ore., cost 0.073c. per square foot. The prints were Van Dykes made from Van Dyke negatives which were several years old. Each print was about 36 x 36 inches.

Erect Company Barracks Building in Three Hours

ONE of the standard army company units—a two-story frame building 43 x 140 ft. in plan—was framed and erected complete at Camp Pike, Little Rock,



TWO HUNDRED WORKMEN COMPLETE ARMY BARRACKS IN LESS THAN THREE HOURS

Ark., on Aug. 26, in two hours and fifty-five minutes, by James Stewart & Co., Inc., the company holding the cantonment contract.

Work was begun at 9 a.m. and at 11.55 the building was inclosed, floors laid, stairs in place, doors hung and windows fitted and screened, roof on, and all scaffolding had been removed and the workmen had left the building.

The amount of lumber required for this size of barracks is 75,000 ft. Two hundred carpenters were employed on the work. A notable feature of the construction was the fact that, in spite of the number of workmen and the high speed at which the work was rushed, not a man received a bruise or scratch.

The schedule of completion was as follows: 9 a.m. —work started; 9:20—posts and studding up for first story; 9:22—joists started for second floor; 10—second floor outside frame started; 10:20—second floor outside frame finished, first story trim and mill work finished; 10:45—joists on second floor finished; 11—flooring on second floor finished; 11:05—rafters started on roof; 11:30—rafters finished; second story trim and mill work finished; 11:55 scaffolding removed and workmen out of building.

The view was taken early in the framing and shows the swarm of workmen. Moving pictures of the work were taken by government photographers for purposes of exhibition and record.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Conveyor Tunnel Roofed While in Use, Stopping Serious Leakage

By Paul R. Prufert
John Wunder Co., Minneapolis

A GRAIN conveyor tunnel 600 ft. long, in which working clearance was very limited, was recently roofed with waterproofed concrete in three weeks by an efficient organization under the writer's direction without interrupting service on the conveyor.

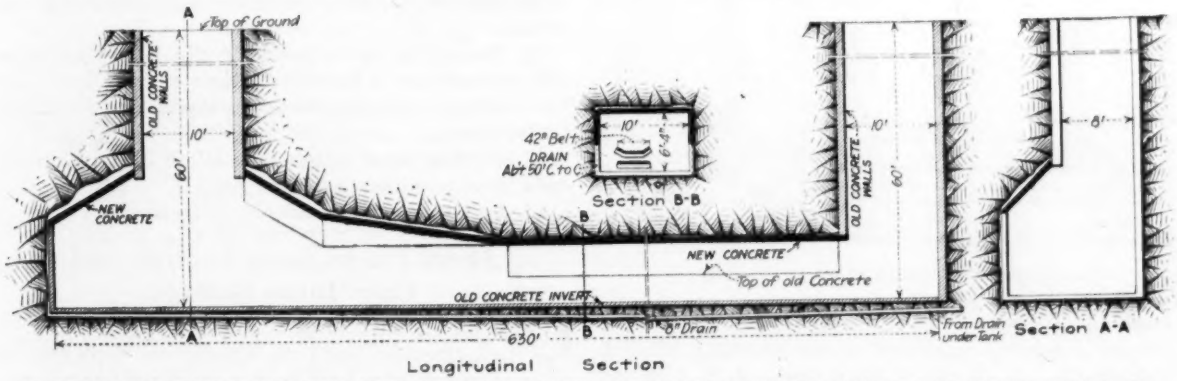
This interesting problem in waterproofing was encountered in connection with construction work at the plant of the Washburn-Crosby Co., in Minneapolis. Early in 1917, this company completed a large grain elevator on a site about 650 ft. from its plant. The elevator was connected with the mills by a tunnel 10 ft. wide by 7 ft. high, located 60 ft. below ground and running through sandstone and shale strata. A 42-in. belt conveyed the grain to the mills. At the time of driving the tunnel an 8-in. sewer was laid under it and the invert and sides to a height of about 3 ft. were lined with 5 in. of concrete. Three-inch pipes were placed in the concrete from the sewer to the top of the sidewalks, about 50 ft. c. to c. As the tunnel was then perfectly dry, it was decided to leave the upper part unlined.

After grain had been run through it for about a month, however, several leaks developed in the roof, especially at the entrance shaft. They grew worse day by day, making it necessary to place sheet-iron watersheds over the belt at numerous points. When the leakage finally became so bad that at the entrance for a distance of 40 ft. it resembled a light steady rainfall, it was decided to line and waterproof the entire tunnel.

After several methods of doing the work were considered and discarded as impracticable, it was decided to line the tunnel with about 6 in. of concrete, using a flat roof slab with ⅜-in. bars, 6 in. c. to c., and to continue the 3-in. drain pipes up to the top of the roof slab, leaving a space between the top of the slab and the rock clear across the tunnel wherever necessary for drainage.

Working conditions were about as bad as could be imagined. The available space in the entrance shaft for taking down material had an area of 4 ft. 6 in. by 2 ft. 6 in. The rest of the shaft was taken up by the elevator legs. The conveying of grain through the tunnel could not be interrupted or delayed during the work and the passageway along the belt had to be kept as free from obstructions as possible. The clear headroom could not be decreased to less than 6 ft. 4 in.

The roof slab at the entrance shaft was centered up first. On account of the steep slope it was necessary to build two sets of centering, one above and one below the slab, the top one being left in place. The concrete was mixed outside and chuted into the tunnel through a 10-in. pipe with a swivel joint 5 ft. above the bottom of the shaft walls. On each side of the old concrete shaft a hole was cut through the old wall and the concrete for the roof slab was spouted into place for a distance of about 10 ft. from the shaft. The concrete for the remainder of the tunnel was spouted into a box, put into wheelbarrows and wheeled to the point of deposit.



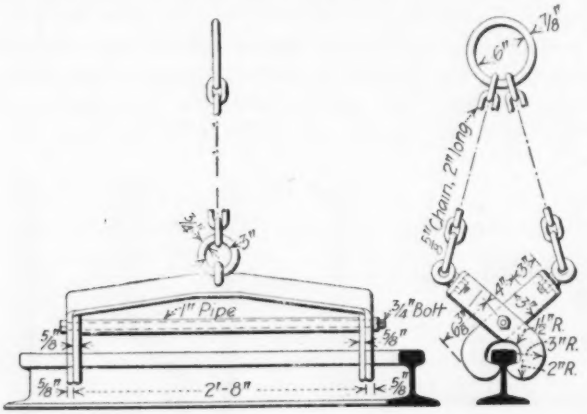
NARROW CLEARANCE DID NOT PREVENT SMALL CREW FROM LINING UPPER HALF OF 600-FOOT TUNNEL IN THREE WEEKS

The work was carried on with a day and a night crew, working 10 hours each. Each crew was divided into three gangs, the first putting up centering, the second concreting the side walls and the third concreting the roof slab. The boards for the roof-slab centering, which ran at right angles to the tunnel, were placed four or five at a time, the reinforcing was laid and the concrete thrown in with short-handled shovels. It was then smoothed down and floated and another section of four or five boards started. It was surprising to see the skill with which the men handled this work after a short period. The belt was protected during the work with a section of sheet iron, which was moved with the concreting.

A 1:2:4 concrete was used, with Trus-Con concentrated waterproofing, mixed in the proportion of 1 gal. of waterproofing to 24 gal. of water. The whole job, including the difficult work at the shaft, was completed in a little more than three weeks. The grain moving had not been interfered with and not a single leak showed after the forms were removed. The work was done by the John Wunder Co., with the writer in charge of design and construction.

Special Tongs Prevent Rails from Seesawing While Being Handled

THE SKETCH shows some simple rail tongs which have been developed on the Atchison, Topeka & Santa Fé Ry., and which have given good service, according to William Barnes, supervisor of work equipment at Topeka, Kan. As described in *American Ditcher Scoopings*, published by the American Hoist & Derrick Co., the length of these tongs, 2 ft. 8 in. between grips, is found sufficient to prevent rails from seesawing while being handled by a crane. The main part of the tongs is made from ⅜ x 3-in. soft steel, the jaws being hinged on a ¾-in. bolt with a 1-in. pipe spreader. Each half of the tongs is connected by a 2-ft. length of ⅝-in. chain to a large ring, which is hooked to the hoisting line.



TONGS HOLD RAILS STEADY IN HANDLING

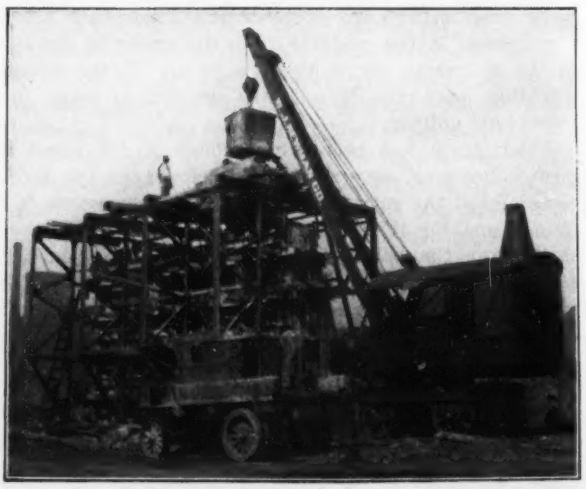
Have This Printed and Keep It Posted in Your Garage

IT MAY sound foolish to tell your drivers to cover their radiators in cold weather to save the extra gasoline it takes to start and warm up a cold engine—but the National Automobile Chamber of Commerce estimates that this and a dozen other small economies that ought to be practiced anyway in the operation of motor trucks and passenger cars can save 125 million gallons of gasoline a year, or more than one-third of the entire quantity of gasoline required in the next twelve months for the use of the army. Following the announcement of the Bureau of Mines that the gasoline supply, if used with care, will be sufficient for all reasonable needs, national automobile organizations have begun a "Save Gasoline" campaign. As many contractors are large operators of both trucks and passenger cars, it may not be amiss to quote a few of the suggestions circulated by the National Automobile Chamber of Commerce. Those which might with profit be posted and enforced in contractors' garages follow:

1. Do not use gasoline for washing or cleaning—use kerosene to cut the grease.
2. Do not spill gasoline or let it drip when filling—it is dangerous and wasteful.
3. Do not expose gasoline to the air—it evaporates rapidly and is dangerous.
4. Do not allow engine to run when car is standing. Most cars are fitted with self-starters and it is good for the battery to be used frequently.
5. Have carburetors adjusted to use leanest mixture possible—a lean mixture avoids carbon deposits.
6. See that piston rings fit tight and cylinders hold compression well. Leakage of compression causes loss.
7. Stop all gasoline leakage. Form the habit of shutting off gasoline at the tank or feedpipe.
8. See that all bearings run freely and are well lubricated—friction consumes power and wastes gas.
9. Protect the radiator in cold weather—a cold engine is hard to start and is short in power.
10. Keep tires fully inflated—soft tires consume power.
11. Do not drive at excessive speed. Power consumption increases at a faster rate than speed. Every car has a definite speed at which it operates with maximum fuel economy.
12. Change gears rather than climb hills with wide open throttle—it saves car and gas.
13. Do not use cars needlessly or aimlessly.

Motor Trucks Spout Concrete and Carry Dump Buckets

CONCRETE handled in dump-body motor trucks on track-elevation work in Chicago is deposited in place by means of a long wooden chute attached to the rear of the body, as shown in one of the accompanying views. The truck is of Garford end-tipping make, with the body temporarily blocked up high above the frame. Thus with the truck at a safe distance from the excavation the concrete can be placed at the far side of the



MOTOR TRUCK CARRIES DUMP BUCKETS HANDLED BY LOCOMOTIVE CRANE FOR FILLING WALL FORMS

MOTOR TRUCK WITH REAR CHUTE PLACES CONCRETE FOR FOUNDATIONS

wide forms for footings of retaining walls and bridge abutments. This avoids shoveling the concrete to distribute it in the forms.

For the upper part of the walls and abutments, large drop-bottom buckets are carried by Garford motor trucks from the central concrete-mixing plant to the work. There locomotive cranes on traction wheels raise the buckets to dump into a hopper at the top of the traveling steel form. From this it is spouted into place. The bucket stands on I-beams across the hopper, thus reducing the spattering of concrete.

Similar motor trucks also remove the material excavated for the foundations and dump it as filling behind the completed footings, the top of which is at street level.

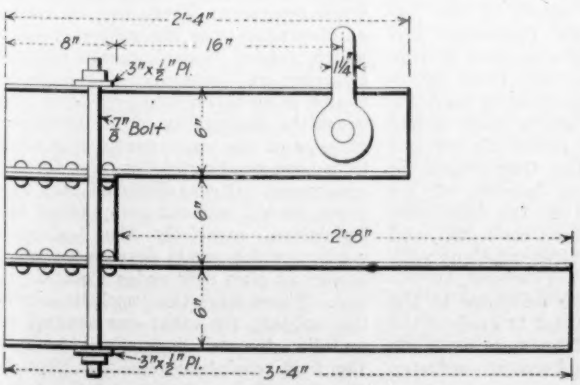
This work is for the elevation of the Chicago & Western Indiana R.R. along Canal St., from 23rd to 29th St. It is under the direction of E. H. Lee, vice president and chief engineer. The W. T. Newman Co. has the contract.

Hook Built of I-Beams Successfully Handles Large Concrete Pipe

By Sidney K. Eastwood

Owego, N. Y.

THE ACCOMPANYING sketch shows a hook for lowering large reinforced-concrete sewer pipe into the trench from a traveling derrick. It was made in the blacksmith shop of a large sewer job. The hook is made up from three 6-in. I-beams clamped together with two



HOOK SOLVES PROBLEM OF HANDLING LARGE CONCRETE PIPE

⅝-in. bolts and 3 x ½-in. plates. The beams are also riveted together through their flanges. An inch and a quarter shackle is placed on the upper arm of this hook midway of the lower arm. Into this the hoisting line is hooked. Five-foot pipe was handled satisfactorily with this hook after considerable trouble had been experienced with the failure of hooks forged from one piece of metal.

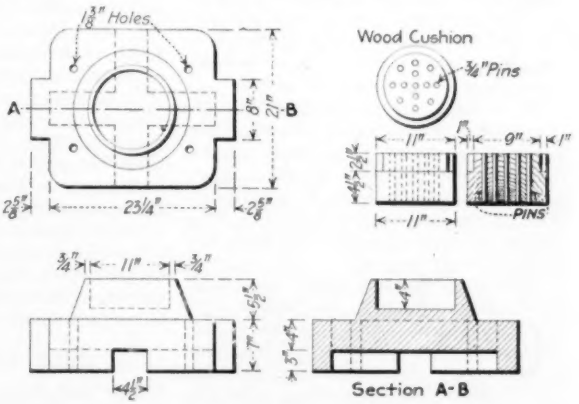
Rapid Driving with Cushion Block Reinforced by Vertical Rods

By George W. McAlpin

Government Dam 39, Florence, Ind.

WITH a specially designed hood fitted with a reinforced wood plug rapid driving of steel sheet piles has been accomplished at Dam No. 39, Ohio River. As many as fifty-four 25-ft. Lackawanna piles have been driven with one driver in one 8-hour shift.

The hood which is made to fit Vulcan hammers, is of cast steel and so constructed that either straight web, gusset, corner or T piles can be fitted into the grooves



ROUND PINS TRANSMIT BLOWS AND SAVE CUSHION BLOCK

in its under side. It is held to the hammer by wire lines or by rods passing through 1⅜ in. holes.

A circular hole in the head permits an oak block to be inserted as a cushion to receive the direct blow of the hammer. This block, 11 in. in diameter, is bound with a 1 x 2½-in. iron collar. This prevents it from mashing up at the top. Holes are drilled in the block to receive ¾-in. round iron pins which transmit the blow from hammer to pile follower. These pins and the collar have proved very successful.

The entire pile hood and block have proved most practical in actual use, no trouble at all being experienced in keeping piling in the groove. Neither does the block have to be changed repeatedly. The hood was designed by L. H. Prell, assistant engineer at the dam.

Cities Spend Far More Than States

The 213 cities of the United States having populations of 30,000 and upward in 1916 spent $33.11 per capita per year for current purposes, interest and outlays (for permanent improvements), compared with an average of $5.10 expended by the 48 states, according to figures compiled by the U. S. Census Bureau. Excluding outlays, the cities spent $24.20 and the states $4.25.

NEWS OF THE WEEK

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

"Go-Ahead" Road-Building Policy Indorsed by Ohio Officials

A "go-ahead" road-building policy for Ohio was indorsed last week at the convention called by the State Highway Advisory Board and Commissioner Cowen to acquaint the state road officials with the principle of state aid and the laws under which the state and counties operate in promoting building of the state system. The resolution urging a continuation of highway construction, introduced by W. A. Alsdorf, secretary of the Ohio Good Roads Federation, was as follows:

"Whereas, No greater national necessity exists than the need of improved transportation facilities, in order to get foodstuffs to market, to relieve congested railroad terminals and to get manufactured products from the factories to the jobber and consumer, and to help Uncle Sam's war program; and

"Whereas, No more effective blow can be struck at the high cost of living than by putting the farmers and market gardeners of the state in close touch with the great centers of population through the construction of a complete system of modern roads available for use in all seasons; and

"Whereas, Ohio has a fixed road program with revenues established and work under way, which in the recent words of Governor James M. Cox, 'must go forward to completion,' and counties and townships are coöperating with the state and nation in highway improvement; now, therefore, be it

"Resolved, By the officials of the State Highway Department and the county commissioners, county surveyors and county auditors of the State of Ohio, that, for these reasons and to meet the exigencies of war, we demand a harmonious coöperation of road officials in the performance of their duties, the abandonment of makeshift policies and the adoption of a vigorous, go-ahead road-building program in the State of Ohio; and be it further

"Resolved, That we pledge our united support to the State Highway Commissioner and the State Highway Advisory Board in the collection and compilation of all data necessary to secure through the action of the National Council of Defense and other agencies of the Federal and state governments an adequate supply of cars for the shipment of road-building materials; and also in the collection of such information as may be necessary in the securing of labor and the marketing of securities."

The meeting was the first of its kind ever called by the officials of the State Highway Department. More than 300 road officials attended.

American Business Indorses Price-Fixing

Convention Held by Chamber of Commerce of United States Passes Resolutions Affecting Industry of the Nation

American business was mobilized at Atlantic City, N. J., on Sept. 17 to 21, when the leaders in every industry in the United States gathered there to see how the industrial, commercial and financial resources of the country could best be utilized to aid the Government in bringing the war to a successful conclusion, as well as aid business itself to come to a definite understanding as to its future in connection with the conduct of the war.

Some of the best work done at the convention, aside from the speeches which inspired those who were present, was done by the Committee on Resolutions, which included men in every line of commerce, industry and finance, as well as men from every section of the country. It was freely pointed out in the convention, which was called the War Convention of American Business, that no committee on resolutions in any assembly of the Chamber of Commerce of the United States had ever included a more representative body of American business than the committee which served so laboriously at this Atlantic City convention.

Catchings Analyzes Conditions

The background of the convention had been that American business, since the declaration of war with Germany, and since the competitive buying of supplies in the United States for the Allies, for the United States and for private business, which has forced prices to an abnormal height, had thrown American industry into chaos. This situation was very clearly defined by Waddill Catchings, chairman of the Program Committee of the convention, and also chairman of the Committee on Coöperation with the Council of National Defense, on behalf of the National Chamber. Mr. Catchings, formerly a president of a number of iron and steel companies, left those industries upon the declaration of war, declaring he did not care to make money out of the war, and placed his services at the hands of the Government in Washington, so that because of his previous experience in the industries with which he has been connected, and because also of his close relations with the Council of National Defense, he was in the opinion of the delegates to the convention well qualified to analyze the present condition of business as it affects Government and private industry jointly.

Newspaper reports did not carry a complete report of Mr. Catchings' address to the convention, nor of the resolution which was adopted by the Chamber of Commerce of the United States at the War Convention which was inspired by Mr. Catchings' address and the background which made necessary the calling of the War Convention. Never in the history of American business have such resolutions been passed at any convention such as that of the National Chamber just ended. Leaders of industry, commerce and finance, supported by less known men from every section of the country, declared in their resolutions that at the earliest possible moment all the purchasing of the Government for the war should be concentrated in one body. They declared for the first time in the history of American industry that it is right, proper and necessary that the Government should have the power to fix prices on all materials needed for the conduct of the war as well as all materials affecting the public interest for the Government itself and for the public at large. It was declared that the Government should by right of necessity have the power of fixing the priority of shipments. It was declared that American business is ready for heavy taxes, for the dissipation of its savings, and that it is ready to turn over its plants to the Government, under Government control, if necessary, and to do any and every other thing which may be necessary for the successful conduct of the war.

Discuss Water Power

One of the features of the convention was a resolution in regard to water power which was discussed by S. A. Osborne, vice president of the Westinghouse company. There was an extended discussion upon the subject, most of which tended toward committing the Chamber of Commerce of the United States to an attempt to urge upon Congress the desirability of the enactment of some of the water-power bills which have been pending in Congress for several years. It was declared that Congress should without delay enact this legislation, especially the legislation pending which would develop the water powers at sites now under Federal control. There were two resolutions upon this subject, the other one tending especially toward irrigation projects. The first resolution requested that the directors of the Chamber of Commerce

of the United States be asked to appoint a special committee to investigate the present need of water-power development and the character and extent of legislation required and to report to the National Chamber as soon as possible. The Committee on Resolutions suggested and the convention indorsed the request that this resolution should be referred to the board of directors of the National Chamber; and the Committee on Resolutions also suggested, which suggestion was also indorsed by the convention, that the other resolution on water power should be referred to the board of directors.

It is understood in Washington, since the convention adjourned, that a special committee on water power will be appointed in accordance with the suggestion in the resolution, which asked for such a committee, and into the hands of this committee-to-be no doubt will be committed the other water-power resolution dealing with irrigation, etc.

The convention, according to those who were present, was an inspiring occasion. James A. Farrell, president of the United States Steel Corporation; John D. Ryan, president of the Anaconda Copper Co.; Henry Bruere, vice president of the American Metal Co.; E. H. Huxley, of the United States Rubber Co., and many other leaders in industry addressed the convention. Herbert C. Hoover, the United States Food Administrator, delivered an address. Very strong resolutions of support for Russia were passed, and especially in regard to further financial support for that new democracy.

To Unify Purchasing Power

In speaking on the subject of unification of Governmental purchasing power and price control, Waddill Catchings said, in part:

"The committee on coöperation with the Council of National Defense, of which I am chairman, has been in intimate contact in Washington with the great industrial problems which have arisen as a result of the large purchases which our Government is making. It is said that our Government will expend for war purposes for our armies and for the allies during the next year nineteen billions of dollars, or more than twenty times the annual gross output of all the subsidiaries of the United States Steel Corporation.

"You are having an opportunity at home of seeing the effect on business of these great purchases, the effect of the withdrawal of material and labor. These interests essential to the industrial fabric are unable at the present time to secure the materials which they need. The interests which are not essential to the industrial life are faced with the great problem of what they are going to do during these times to carry their structure from the present over into the future. The result of the competitive bidding by the Government for the vast quantities of materials and supplies which it needs, and of the competitive bidding by business for what is left, has produced high prices. These high prices have produced great discontent throughout the country. Our people have not viewed with unconcern the acquiring of great riches in this time of national sacrifice and distress. There are great labor difficulties arising in all sections of the country. We are having here the same experience which England had in securing the exceptional effort of labor when an indirect effect of that exceptional effort was the creation of great riches.

To Reduce High Prices

"You know that when business men are told that they should not charge a high price for materials and supplies, that that is entirely ineffective unless some action is taken to create a different condition. As long as there is a great demand, so long will prices continue; and it is idle for us as business men to respond to the patriotic addresses that are made unless we carefully discuss how we can carry into effect the ideas that are expressed, and make them effective.

"It is for you to determine if this country has vested in our Government at Washington sufficient power in times of peace to settle these extraordinary problems which have arisen in connection with the war as a result of these vast purchases. In this great democracy of ours powers must be vested in the Government before the Government can act, and it is not possible for the authorities in Washington to act in regard to the problems existing as might seem best to them. It is only possible for them to act in accordance with the statutory power which has been given to them. The War Industries Board was created by the Council of National Defense, but the Council of National Defense has no authority under the law to act; it is a body that was created in time of peace to investigate, report and give advice. The War Industries Board has been created by that body. It can have no power which was not possessed by the body which created it. The War Industries Board is rendering great service today in advising Government officials in bringing centralization to the Government purchases, but the purchasing for the Government today is being done just as it was done in times of peace by the many bureaus and departments of the War Department and of the Navy Department. Independent purchases are being made today by the Signal Corps, the Engineer Corps, the Naval Corps and all of the various quartermasters. The War Industries Board is doing all it can to bring about coöperation among them, but any careful study of the situation in Washington will lead you, I think, to the conclusion that what they are able to accomplish, however great it may seem, is not great in comparison with the work which is to be done.

Need War Board with Power

"I say to you without hestitation that without loss of time our Government should be given power to create a war board similar to the Ministry of Munitions in England. This should be a board which would assemble under one control the trained buyers of the various departments of the Government. It should be drawn from the various competing bodies and gathered together; but these competing bodies of Government officials should be reinforced by men from civilian life. Most of those men are probably in Washington at the present time advising the Government as best they may, but these men should be no longer advisers; they should be in the actual service and doing actual purchasing for the Government.

"The Government is in contact with business today on a scale never heard of in our Government before. Army and navy officers who are trained with special work and who have had some experience with special buying in the past are called upon to deal with these enormous problems. Our committee says unhesitatingly that these men should be relieved for service at the front, except such of them as are necessary to retain experience from what has been done. All who have experience should be called into the Government service.

Board Must Have Power

"A board such as I have mentioned would have to have power to determine prices when negotiation between buyer and seller can no longer take place because of the unprecedented demands for material. As to those materials which are necessary for the national defense, those materials which are necessary for the preservation of our essential industrial life, where negotiations between buyer and seller can no longer be had, our committee says unhesitatingly that the Government should have authority to determine the price upon some fair basis. Such a body would have to have power to determine priority, the order of distribution.

"We say to you that you cannot expect the material of our country, which is not equal to the entire demand, to go where it is most needed into national defense or for the preservation of our essential industrial life by merely competitive bidding. We say to you that the experience that has been acquired should be made use of here.

"If you say that the Government should not interfere with business, our committee says that the purchasing of nineteen billion dollars' worth of materials and labor is an interference with business, and that the suggestion is not that there be no interference, but that there be orderly interference, and not disorder. If you say that the loss of trade should be taken into consideration, our committee says that when the entire industrial life of our nation is concentrated upon the single purpose of winning the war, there is no loss of trade. If you say that the machinery of the Government should be developed and used for the purposes of the War and Navy Departments, we

think the answer is that these are temporary problems, that business is asked to give the Government great power temporarily; that the situation which we are asked to meet exists only during the war, and that therefore a tempor ary structure should be created so that at the end of the war we can so far as possible return to normal conditions.

"If you say that the situation is too big, too complicated, that our Government cannot undertake the regulation of prices or the regulation of priorities, we say to you that chaos exists in business today, and that order must be brought out of that chaos. If our industrial energy is to be centered behind winning the war, these problems must be solved. We believe that you can bring order out of this chaotic condition at a much earlier date than it will be brought by the natural course of events. That can be done if you approach our Government and point out that business is willing to submit to control in these times; that you do not insist upon full freedom of action when winning the war is at stake. If that is done, cooperation can come about between business and the Government which cannot exist at the present time. Business will no longer be on the opposite side of the table in any negotiation. Business can sit side by side with the officials of the Government in an effort to solve these problems."

Digest of Resolutions

The convention came to an end Sept. 21 with the passage of some of the most remarkable resolutions ever passed by American business.

One resolution pledged the support of business to the war in the most comprehensive and sweeping terms. The resolution declares that American business is ready for heavy taxes, for the dissipation of its savings, is ready to turn over its plants, and to do any and every other thing which may be necessary to prove that American business is behind the war until the last gun is fired.

Another resolution passed declares that at the earliest moment all the purchasing of the Government for the war should be concentrated in one body. It declares in an unequivocable manner for the first time in the history of American business that it is right, proper and necessary that the Government should have the power to fix prices on all materials needed for the conduct of the war as well as all materials affecting the public interest, for the Government itself and for the public at large.

Another resolution indorsed the principles laid down by the Committee on Labor of the Council of National Defense, and as set forth by the Secretary of Labor, to the effect that employers and employees should not attempt to change existing standards of work during the period of the war.

The convention indorsed another labor resolution of great importance. This was in support of the idea of a Federal board appointed by the President to adjust disputes. During the process of adjustment, American business declared, there should be no shutdowns, lockouts, strikes or other cessation of industry. Business pledged itself to accept decisions made by such a board and invited the coöperation of labor. During some of the discussions in the group meetings of the convention some delegates advocated compulsory arbitration of labor disputes. The Committee on Resolutions refused to report a resolution that would try to tell labor what it must do, and the convention took the attitude that American business should merely invite the coöperation of labor.

The usefulness of the United States employment service under the Department of Labor, which brings employers into closer connection with workers seeking employment, was indorsed. The convention indorsed the action of the directors in creating a foreign commission to proceed abroad and study and report upon the means whereby business may adapt itself to the problems that will arise during and after the war.

The convention having placed itself on record in favor of governmental fixing of prices on essential products, the Chamber went on record as advising a revision of prices based on the cost of production. A plan of allowing business to pay war taxes in four quarterly installments instead of annually was suggested and approved.

The convention requested every organization member to call a war meeting of its own organization before Nov. 1 to take to these organizations the lessons of the convention.

Railroad transportation was declared inadequate and the Chamber urged upon Congress the enactment at the present session of legislation giving the President or the Shipping Board power to suspend during the war the provisions of law govering coastwise shipping.

The daylight-saving plan, it was declared, would conserve the nation's supply of coal. The Chamber urged action by Congress and the President to make the daylight plan effective as a war measure. Improvement of public highways for military roads and in order to move foodstuffs economically was indorsed.

The Committee on Resolutions suggested that a number of recommendations be referred by the Chamber to the board of directors with power to act. Among these was a recommendation that the National Chamber make a prompt and careful study of labor conditions after the war.

The Committee on Resolutions requested that a number of recommendations be referred to the board of directors without advice. Among these was a recommendation regarding water-power legislation which asked that Congress should enact legislation for the development of water power at sites now under Federal control without delay; another recommendation so treated suggested that the business interests of the country would be best served if the Federal Trade Commission or some similar Government commission be empowered to tell business what it is or is not permitted to do jointly with competitors in a lawful manner; another recommendation was intended to approve the action of the adjutant general of the State of New York in organizing chambers of commerce of that state.

The Chamber went on record as urging a vast and immediate increase in the number of American ships.

To Start on Big Construction Program for Flood Control

About $10,000,000 worth of work will be placed under contract Nov. 15 as part of the $25,000,000 flood-prevention project of the Miami Conservancy District, Dayton, Ohio, the largest project of its kind ever undertaken. The work is divided into a number of contracts, including five dams, road construction, levee building, river channel excavation, revetment, retaining walls, etc. The larger contracts, according to a statement by Arthur E. Morgan, chief engineer of the Conservancy District, contain numerous smaller pieces of work for which the main contractor may not be equipped and which he may desire to sublet. The chief engineer of the district will be pleased to hear from any persons or firms who are in position to take any of these subcontracts, and will put them in touch with those who will bid on the larger contracts as a whole.

Some of the kinds of work which may be included in these subcontracts are: Clearing and grubbing trees from base of dam; soil stripping from base of dams, levees and borrow pits; surface dressing and grassing of dams; seeding or sodding of levees; trimming slopes of river channels; removal of buildings; excavation for minor drainage systems; construction of levees; excavation and fills for highway construction; rolled gravel paving for highways; water-bound macadam paving for highways; street paving; bituminous macadam, brick, concrete, etc.; guard rails for highways; construction of wire fences; laying vitrified pipe; gutter paving; stone masonry; stone paving; riprap; small concrete structures; road culverts; concrete slope revetment for river banks; concrete blocks for slope protection; setting flood gates in canals and sewers.

Degnon Contracting Company Gets 18-Mile Shandaken Tunnel

The Board of Water-Supply of the City of New York has awarded to the Degnon Contracting Co. the contract for the 18-mile Shandaken tunnel, a portion of the Catskill aqueduct which will connect the Schoharie and Esopus watersheds. The Degnon company was low bidder, with an estimated cost of $12,138,738. The main tunnel section is horseshoe-shaped, 11 ft. 6 in. high and 10 ft. 3 in. wide, concrete lined.

War Department Has Authorized 46,000 Engineer Troops

According to information received by *Engineering News-Record* from the office of the Chief of Engineers, United States Army, the War Department has authorized about 46,000 engineer troops to be used for gas and flame work, mining, water-supply, construction, depot work, surveying, roads, forestry, rail roads, etc. The term "authorized," it is explained, means that the policy has been adopted whereby, at some future time, when the necessity arises, such engineer units will be organized.

At present the following have been ordered raised immediately:

	Men
1 Regiment, 20th Engineers, Forestry, at American University, Washington, D. C.	1,200
1 Regiment, 21st Engineers, Light Railway at Rockford, Ill	1,200
1 Regiment, 23rd Engineers, Highway, at Annapolis Junction, Md.	1,200
1 Regiment, 25th Engineers, Construction, at Ayer, Mass. (less 1 company camouflage)	1,000
25th Engineers, Construction, 1 company camouflage, at American University, Washington, D. C.	200
1 Regiment, 26th Engineers, Supply and Water-Supply, at Wrightstown, N. J.	1,200
Total	6,000

The recruiting officers are now making enlistments for these organizations. Very little difficulty in raising these men is anticipated because the Chief of Engineers now has on lists enough men to fill up these organizations.

Orders will soon be issued calling into active service members of the Engineer Reserve Corps to join the organizations which have been ordered.

"Handy Men" Wanted

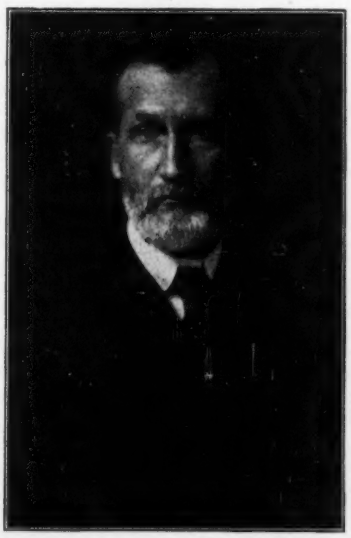
"Handy men" having some knowledge in any of the technical work of the new regiments of engineers of the National Army can now volunteer and see active service in France. Young men 18 to 21 are most desirable; in fact, many experienced officers believe that 18-to-21 boys make the best soldiers. The consent of parents is not now required for the enlistment of such. Many parents, noting that their boys are anxious to do their patriotic share in this trying hour, see the wisdom of their volunteering in the engineers, so that when this war is over they will have a mechanical trade such as railroading, house construction, electricity, water-works, bridge work, iron work, sawmill work, mining, etc.

Depot Detachments at Each Camp

Engineer depot detachments at each of the cantonments, such as Camp Dix, Wrightstown, N. J., each consisting of 54 men and helpers (including any married men whose wives sign waivers) have been authorized by the War Department. Applicants are advised to write to the engineer officer at any of the cantonments setting forth qualifications, etc., and applying for card authorizing enlistment. Upon receipt of the card they will then be accepted for enlistment at the nearest recruiting station.

Charles Lee Crandall

Prof. Charles L. Crandall, Cornell University, whose death on Aug. 25 was noted in these pages last week, was one of the pioneer professors of engineering in this country. Though only 67 years of age at his death, his term of professorial service was coincident with the life of the university from which he graduated and which he served. For only two years, between 1872, when he graduated, and 1874, was he absent from the faculty of the College of Civil Engineering at Cornell. In 1874 he became an instructor in civil engineering and by the regular course of promotion reached the chair of railway engineering and geology in 1895. In 1902, on the death of Dean Fuertes, he took charge of the college until 1906, at the same time holding his regular chair in



PROF. CHARLES LEE CRANDALL

the faculty. In 1915 he retired from active duty and became emeritus professor.

He early entered the field of technical authorship. In 1886, "Tables for Computation of Railway and Other Earthwork" was published, and in 1888 a second edition appeared. Then followed, in 1893, "Notes on Descriptive Geometry," "Notes on Shades, Shadows and Perspectives of the Transition Curve," and, in 1907, a textbook on "Geodesy and Least Squares." In 1909 Professor Crandall produced a "Field Book for Railroad Surveyors." In 1913 as joint author with Professor Barnes, of Cornell University, he published "Railroad Construction." Besides these duties of authorship and his usual professorial duties, he was from 1870 to 1891 city engineer of Ithaca, N. Y., where the university is situated. An interesting commentary on the high regard with which engineering students were held in the early days is the fact that he was appointed to this post while he was a junior in the college.

As his books and the character of his instruction would indicate, Professor Crandall was interested primarily in railroad construction, and in pursuance of that interest he was an active member of the American Railway Engineering Association, serving on a number of committees, particularly on the committee on iron and steel structures, which presented an elaborate report some years ago on the subject to which it was assigned. His services to the college are emphasized by his connection with the alumni. He served as corresponding secretary of the Cornell Society of Civil Engineers, in which capacity he not only maintained a list of all the alumni, with their locations, but also a correspondence bureau which was devoted largely to the employment of the alumni.

No better epitome of his life work could be expressed than the words of the university faculty in a motion at the time of his retirement from active teaching in June, 1915: "What is probably Professor Crandall's greatest usefulness is the result of his high, unselfish character. His whole life has been given to the devoted service of his associates and of his students. Graduates from the College of Civil Engineering have no memories that do not include a feeling of affection and thankfulness to Professor Crandall. Of kindly disposition and practical sound sense, sympathetic in his intercourse with the students, quiet and modest in manner, but with strong convictions as to truth and justice in any matter brought before him, and always ready to sacrifice personal interest in following the dictates of duties, Professor Crandall has won the warm esteem of all who have come within his influence during his two-score years of service at Cornell."

New Haven Railroad Will Widen South Boston Cut

A contract has been awarded and work will be started at once on the widening of the South Boston cut of the New York, New Haven & Hartford R.R. at Boston. At present all traffic to and from the piers, yards and industries of the South Boston freight district has to pass through a half-mile bottleneck which, though double-track, has insufficient clearance for two trains of present-day equipment to pass. Train movements through the cut average one every three minutes during the day.

The cut will be widened to allow four tracks with ample clearance. Eleven street bridges will be rebuilt, steel being used for the superstructures. The street approaches will in some cases be somewhat raised, while the tracks will be depressed to El. 10 below mean high water. A pumping plant with a discharge capacity of 4000 gal. per min. will be installed to drain the cut.

Estimated quantities include 120,000 cu.yd. of excavation, 20,000 cu.yd. of masonry, 10,000 sq.yd. of street surfacing, 1½ miles of drains and 3 miles of track. The cost is estimated at $1,000,000 and the work is expected to take eight months.

PERSONAL NOTES

H. A. WOODS, assistant chief engineer of the Grand Trunk Pacific Ry. at Winnipeg for 15 years, has resigned.

O. L. GEARHART is serving as resident engineer on 3½ miles of concrete pavement in Burean County for the Department of Public Works and Buildings, Division of Highways, representing the reorganized Illinois State Highway Department. Mr. Gearhart has just finished 10 miles of earth-road improvement in Stark County.

S. B. TAYLOR, who has been engaged in logging engineering work since 1912, with offices at Dallas, Ore., is constructing a 30-mile logging road for the Pelican Bay Lumber Co., of Klamath Falls, Oregon.

SLOAN, HUDDLE, FEUSTEL & FREEMAN, consulting engineers, of Chicago and Boston, announce that on Sept. 15 their general offices in Madison, Wis., and their local office in the Peoples Gas Building were removed to the Conway Building, Chicago. WILIAM F. SLOAN has assumed personal charge of the Eastern office at 14 Kilby St., Boston, as resident partner.

EDWARD J. LANGFORD, chief engineer of the New York, Westchester & Boston Ry., has been commissioned a major in the Engineer Officers' Reserve Corps.

MORGAN T. GUM, of Frankford, Del., formerly road engineer of Sussex County, Delaware, has accepted a position with the State Highway Department. Mr. Gum is succeeded by WILLIAM E. HAWKINS.

HARRY E. BYRAM has been appointed president of the Chicago, Milwaukee & St. Paul Railway.

W. J. JAMIESON has resigned as assistant engineer of the United Verde Copper Co., Clarkdale, Ariz., to accept appointment by the Governor of Arizona as engineer member of the Commission of State Institutions, with headquarters at Phœnix. Appropriations by the last legislature called for a considerable amount of construction work to be done under the supervision of this commission.

GUY H. CHASE, commissioner of streets, sewers and engineering, of Fitchburg, Mass., has resigned to devote his entire time to private practice. Mr. Chase is a member of the firm of Parker, Bateman & Chase, civil engineers, of Fitchburg, Ayer and Clinton, Massachusetts.

IRA DYE has been appointed night superintendent of the Weir Frog Co.'s shop at East Norwood, Ohio.

D. A. WATT, formerly principal assistant engineer in the United States Engineer Office, Albany, N. Y., has left that work for active duty in the office of Chief of Engineers, Washington, D. C., having been commissioned a major in the Engineers Officers' Reserve Corps.

C. H. FOOTE has returned to El Paso, Tex., after an absence of several years, during which period he was associated with the engineering department of the El Paso & Southwestern Ry. as inspector of bridges and buildings. Mr. Foote also built several highway bridges for the State of Arizona. He has now established a general contracting business, with headquarters at El Paso.

S. BUFFINGTON has been appointed resident engineer of the Kansas City, Mexico & Orient Railroad Co., to take the place left vacant by the resignation of H. B. HOLMES, chief engineer, who has become associated with Coverdale & Colpitts, of New York City. Starting as a rodman, Mr. Buffington has been connected with the Orient Lines since 1907.

E. H. MORRIS has resigned his position as assistant engineer, maintenance-of-way, with the Evansville & Indianapolis R.R., to accept an appointment on the engineering staff of the Public Service Commission of Indiana, with headquarters at Indianapolis.

HERBERT COHEN, for eight years superintendent of construction, United States Public Buildings, has been transferred to the War Department as superintendent of construction, Signal Service at Large, taking charge of the design and construction of the aviation station near Honolulu, work upon which is now being commenced.

H. J. WILD has given up his work as professor of engineering, Pennsylvania Military College, and is now on active duty as captain in the Engineer Officers' Reserve Corps. He is serving as instructor at the Plattsburg training camp.

HOLTON COOK has been appointed resident engineer for the Fargo Engineering Co. on the construction of the Foote Development of the Consumers Power Company.

M. A. STAINER has been promoted from assistant engineer of the Gulf, Colorado & Santa Fe Ry. at Galveston, Tex., to roadmaster of the Beaumont division, with headquarters at Center, Texas.

R. A. CONARD, for several years past superintendent of the Sewer Department, Jacksonville, Fla., has been appointed civil engineer, with the rank of lieutenant, in the United States Naval Reserves, and has been detailed for special duty in Haiti. He was formerly connected with the Sewer Department at Washington, D. C., and served two and a half years on the construction of the Panama Canal.

JAMES NISBET HAZLEHURST has resigned as chairman of the Board of Consulting Engineers for the City of Atlanta, Ga., and from the chairmanship of the executive committee of the Affiliated Technical Societies of Atlanta and the State of Georgia, on the expectation of leaving shortly for duty with the American Expeditionary Force in France.

ROBERT J. PHILLIPS has resigned from the department of designs of the American Steel Co., Havana, Cuba, to enter the Officers' Reserve Corps training camp, Plattsburg, New York.

CAPT. HENRY L. BOWLBY, formerly state highway engineer of Oregon and of Washington, has been appointed senior highway engineer of the Office of Public Roads and Rural Engineering, Washington, D. C. His headquarters will be in Denver. Captain Bowlby is a West Point graduate, although he did not enter the army. He has since been commissioned captain in the Engineer Officers' Reserve Corps. For several years he served as professor of civil engineering at the University of Washington. He was state highway engineer of Washington from 1909 to 1911, and state highway engineer of Oregon from 1913 to 1915.

J. E. ROBERTSON, at present professor of highway engineering in the Missisippi State Agricultural College, and who for the past three summers has been in charge of road construction in Shelby County, Illinois, has been appointed road engineer for this county, vice MURRELL MIDDLETON.

ALEXANDER L. LUCAS is at present civil engineer and superintendent of construction, United States Quartermaster Corps, Ft. Douglas, Utah. Mr. Lucas served during the Civil War in the regular army, and then was attached to the headquarters of the Fifth Military District, Austin, Tex., as topographical engineer from 1869 to 1871. He then became bridge engineer of the Guatemala Central Ry., Central America, in 1893, leaving his work to become United States assistant engineer in 1896, with headquarters in San Francisco. Mr. Lucas was engineer in charge of the exploration, Isthmus of Darien, South America, for the Isthmian Canal Commission, in 1900, having headquarters at Cartagena, Republic of Colombia. In 1911 he became bridge and designing engineer of the Bureau of Public Works, Porto Rico, and in 1910 bridge and designing engineer, Compania Ferrocarril, Nov.-Oestre de Mexico, with headquarters at Nueva Casas Grandes, Mexico. From 1911 to 1916 he was in private practice as bridge engineer, which work he gave up to take the position mentioned above.

J. HAMPTON BAUMGARTNER, publicity representative of the Baltimore & Ohio R.R., has resigned to become assistant to S. Davies Warfield, president of the National Association of Owners of Railroad Securities.

C. E. HARRIS, of the contracting firm of Harris & Griffin, Norwich, N. Y., is at present at Linden, N. Y., in charge of the construction of sewage-disposal work at the Genesee County Home.

Engineer Officers' Reserve Corps Assignments

The following-named officers of the Engineer Officers' Reserve Corps now on duty at the engineer training camp, in the vicinity of Washington, D. C., are relieved from duty at that place and will report at the proper time at the divisional training camps indicated below for duty with the engineer regiments and engineer trains of the National Army at those places:

To Annapolis Junction, Md.

First Lieuts. Daniel M. N. Turner, John E. Hoffman, Robert S. Glose, Andrew M. Stevenson, Charles Weiss, Andrew E. Bryans and William F. Schwerin.

For assignment to the Three Hundred and Fourth Engineer train, Annapolis Junction, Md.: First Lieuts. Edward T. Collins and Clinton W. Morgan; Second Lieuts. Samuel R. Hursh, James R. Wilson and Edward A. Hill.

To Petersburg, Va.

For assignment to the Three Hundred and Fifth Engineers, Petersburg, Va.: Majs. Arthur A. Reimer and Elihu H. Ropes; Capts. George F. Hobson, Irving P. Kane, Joseph T. Kelly, Jr., J. Vinton Birch, Vinton D. Cockey, Myron H. Peck, Howard H. George, Alexander C. Knight, George W. Knight, William R. Grunow and Graham B. Bright; First Lieuts. Samuel H. Sherrerd, Case B. Rafter, Robert C. Levis, Matthew J. Hoff, Frank Lloyd Weaver, Caleb S. Kenny, Donald S. MacBride, J. Camden Brady, Irl D. Brent, Charles W. Chesley and Ward H. Ream; Second Lieuts. Alexander W. Yereance, Charles Lee Packard, Wilson T. Ballard, Edward M. Stuart, Rush F. Miller and Anson S. Hathaway.

To be attached to the Three Hundred and Fifth Engineers, Petersburg, Va.: First Lieuts. Henry B. Ross, Herbert R. Haar, Merritt T. Cooke, Jr., Perry S. Abell, Willard W. Troxell and Marshall W. McDonald; Second Lieuts. Fred G. Rockwell, Kenneth B. Jones, Harold F. Bucher, Charles R. Martin, Karl J. Eisenhardt, James N. Gregory and Henry H. Mapother, Jr.

For assignment to the Three Hundred and Fifth Engineer train, Petersburg, Va.: Capt. Thomas J. Powell; First Lieuts. Russell A. Warner, Jacob Shlesinger and Clift Hornwall; Second Lieuts. John T. Morgan and Robert F. Kohr.

To Columbia, S. C.

For assignment to the Three Hundred and Sixth Engineers, Columbia, S. C.: Majs. William M. Lamson and Thatcher T. P. Luquer; Capts. Thomas C. Clarke, Charles D. P. Robinson, Richard W. Berliner, George H. Bunker, Stewart Mitchell, Wylls H. Taylor, James G. Ross, Thomas H. Allen, Herbert C. Whitehurst, Cambridge M. Trott and Arthur C. Forbes; First Lieuts. Harry B. Vaughan, Jr., Carl L. Raymond, Lois L. Adams, James D. Andrews, Jr., Thomas E. Snook, Jr., Carl W. Mengel, John A. Martin, John R. Stewart, Orton B. Stauffer, Samuel P. Graves, John T. Lynch and Ellison S. McKissick; Second Lieuts. Ralph Millis, George M. Dillingham, Lloyd D. Knapp, David L. White, Walter Carter and Blight S. Robinson.

To be attached to the Three Hundred and Sixth Engineers, Columbia, S. C.: First Lieuts. Francis W. Chapman, Ambrose Harwell, James C. Fitz Simmons, Clarence B. Cooper and Albert T. DeRaum, Jr.; Second Lieuts. Landon E. Rosser, Ruel E. Nottingham, William E. Mathews, Leonidas P. Denmark and Charles P. Townsend, Jr.

For assignment to the Three Hundred and Sixth Engineer train, Columbia, S. C.: Capt. James R. Crocker; First Lieuts. Page B. Blakemore and Charles C. Lynde; Second Lieut. George F. Lynde.

To be attached to the Three Hundred and Sixth Engineer train, Columbia, S. C.: Second Lieuts. Julian Loebenstein and Charles S. Boyce.

A. MARSTON, dean of the School of Engineering, Iowa State College, has been commissioned major and placed in command of the Iowa Engineer Troops (First Battalion, Iowa Engineers) and has been mustered into the Federal service. Major Marston is now located at Camp Dodge and is concerned with the engineering required in the construction of the camp. MORRILL W. MARSTON, his son, has been commissioned second lieutenant in the regular army, and is now with the 40th Infantry Regiment.

HENRY F. BLOOD, for some years chief examiner of plans of the City of Portland building department, will have charge of the structural features of the new 1,000,000-bu. elevator to be built by the Commission of Public Docks. The mechanical equipment will be designed by J. M. WITHERSPOON, consulting engineer, Chicago.

J. E. GIBSON, formerly principal assistant engineer of the American Pipe and Construction Co., Philadelphia, has been elected manager of the city water department of Charleston, S. C. Mr. Gibson will assume his duties when the property of the Charleston Light and Water Co. is transferred to the city. Mr. Gibson is familiar with the water-works at Charleston, having assisted in the design, construction and testing of all the equipment of the Goose Creek plant. He also assisted in the original investigation to determine the methods and procedure to be followed in the treatment and filtration of this water, and has kept in constant touch with the property since that time. Graduating from the University of Arkansas in 1894, he was assistant engineer with Jay M. Whitham, consulting steam and hydraulic engineer, Philadelphia, until 1896. Spending one year with the Moro Phillips Chemical Co., Camden, N. J., as mechanical engineer of power-plant construction, he became superintendent and engineer of the Waukeshaw Water-Works Co., which was owned and operated by the American Pipe and Construction Company.

FRANCIS W. BLACKFORD and FRANCIS J. TAYMAN have opened an office for general practice as mine and civil engineers at Miami, Okla. Mr. Blackford was for four years chief engineer of the Cerro-Pasco Mining Co., in Peru, South America, and later on railroad and mining work in Mexico and Central America. Mr. Tayman has spent the last two years in the lead and zinc district of southeastern Missouri, and previously was engaged for 12 years in mining work in Mexico.

DR. A. W. FREEMAN has secured release from his connection as epidemioligist with the United States Public Health Survey at Cincinnati, where he is directing a sanitary survey of the Ohio Valley, to accept the appointment as health commissioner of Ohio.

GEORGE W. GRAFF, assistant engineer with the Pitometer Co., is now in Buffalo working to reduce the excessive water consumption. Previously to his connection with the Pitometer Co., Mr. Graff was chemist in charge of the filter plant at Troy, N. Y., and acted as inspector for the Water Department during the construction of additions and alterations to that plant during the last year.

WILLIS B. HAYES, superintendent of construction, Treasury Department, has been commissioned major in the Engineer Officers' Reserve Corps.

RALPH W. OREBAUGH, who was superintendent of public works at Atlantic Highlands, N. J., has been elected city manager of Westerville, Ohio, to succeed R. F. BLINN, resigned.

O. B. LACKEY, resident engineer of the Southern Ry. at Old Fort, N. C., has been promoted to supervising engineer, with office at Washington, succeeding M. P. NORTHAM, resigned.

J. M. SALMON, recently general manager and engineer of the Louisville Bridge and Iron Co., Louisville, Ky., and before that assistant bridge engineer of the Louisville & Nashville R.R., has been appointed bridge engineer of that railroad. He succeeds F. A. BUSSE, resigned to enter military service.

M. C. WELLBORN, city engineer of Austin, Tex., has resigned to accept the position of division engineer with the Texas State Highway Department, organized three months ago with GEORGE A. DUREN as chief engineer.

W. W. MATHEWS, formerly assistant engineer with L. K. Sherman, of Chicago, is on his way to Europe for service with the aviation section of the United States Army. He has the rank

of first lieutenant. Until about 18 months ago he was an assistant engineer with the Sanitary District of Chicago. More recently he was engaged on the construction of Camp Custer, the cantonment at Battle Creek, Michigan.

H. T. FROST, of Chicago, is assistant to E. H. BENNETT, consulting architect for the United States Army cantonment at Rockford, Ill. He is in direct and responsible charge of the work on the ground. The construction of this cantonment, known as Camp Grant, was described in *Engineering News-Record* Aug. 30.

HOWE & WISE, Houston, Tex., have been retained as consulting engineers to Harris County, in which Houston is located, to advise with W. N. Thatcher, county engineer, as to the expenditure of $1,100,000 bonds voted this spring and recently sold. Concrete roads will be constructed with $100,000; the remainder will go to treat 215 miles of shell and gravel roads with a bituminous top of some kind not yet determined upon.

OBITUARY

LIEUT. MONTGOMERY ARNOTT, formerly in the employ of the Edmonton, Dunvegan & British Columbia Ry., Edmonton, as a civil engineer, was recently killed in action in France.

HENRY B. MCINTIRE, of Wilmington, Del., formerly chief engineer of the Water Department of that city, died Sept. 11. His early work was on construction of the Philadelphia, Baltimore & Washington Railroad.

Notes from

MAKERS OF PLANT AND EQUIPMENT

E. B. Hotchkiss, of the American Steel Export Co., sailed Aug. 28 for France. Mr. Hotchkiss will visit France, Italy and Spain in connection with a number of large engineering problems. Incidentally he will make certain investigations in these countries for the American Steel Export Co. and also act as a special representative of its engineering department in that part of the world. Mr. Hotchkiss resided in France and Belgium for over 19 years. During this time he had charge of a large number of very important engineering works.

J. B. Beall, for the last two years manager of factory sales for the Wayne Oil Tank and Pump Co., of Fort Wayne, Ind., has been assigned to the management of a new branch office located at Cleveland, Ohio. J. D. Rauch, formerly treasurer of the American Steel Dredge Co., of Fort Wayne, Ind., and for the past two months employed as engineer by the Wayne company, has been appointed manager of factory sales. Three additions have just been completed by the Wayne company, doubling the former floor space, and four acres have recently been purchased immediately west of the main office building for an addition to the heavy metal tank shop.

B. F. Devine has recently been made assistant advertising manager of the Chain Belt Co., Milwaukee. Mr. Devine is at present assistant manager of the mixer department. He will hold these two positions. Mr. Devine has been

B. F. DEVINE

with the Chain Belt Co. for nine years and has worked his way up from the shop to his present position. He has been traveling from Cleveland to Denver for the past three years for the company, pushing Rex products and Rex mixers.

E. Jordan, of Toronto, has been appointed chief engineer of L'Air Liquide Society, with headquarters at Montreal. He succeeds E. Royer, who recently resigned.

The Wyckoff Pipe and Creosoting Co., Inc., New York, is furnishing several hundred thousand feet of creosoted wood conduit for carrying underground wires of the New York, New Haven & Hartford R.R. The Wyckoff company has also furnished over a million feet of conduit to the Bell telephone companies this year for wires underground.

Norman R. McLure, for the past three years chief engineer of the Phoenix Iron Co., of Phoenixville, Penn., has resigned that position and formed a connection with the Taylor-Wharton Iron and Steel Co., of High Bridge, N. J. Mr. McLure will assist for the time being in the construction and operation of the extension to the plant of the Tioga Steel and Iron Co., a subsidiary in Philadelphia in which the ordnance contracts recently taken by the company from the United States Navy Department will be executed.

The Universal Concrete Products Co., 208 South La Salle St., Chicago, has the following new officers, elected by the board of directors on Sept. 17: President, C. F. Massey (who is president of the C. F. Massey Co., makers of concrete pipe, etc.); vice president, T. W. Siemon (connected with the Union Switch and Signal Co.); treasurer, F. V. Shannon. The company's principal specialty is hollow-concrete poles. These are made by the centrifugal process described in the *Engineering News-Record* of May 24.

TRADE PUBLICATIONS

Troy motor truck trailers are described and illustrated in a new bulletin issued by the Troy Wagon Works Co., Troy, Ohio.

The Chain Belt Co., Milwaukee, Wis., has issued Bulletin No. 77, descriptive of the smaller sizes of Rex concrete mixers, also Rex pavers.

The Worthington Pump and Machinery Corporation, 115 Broadway, New York, is sending out Bulletin W-602 on turbine pumps for high-head service.

Knudsen packless swivel joints are described in a booklet issued by the Universal Valve Co., Burlington, Iowa.

The Venturi Department of the Builders Iron Foundry, Providence, R. I., has issued Bulletin No. 143, showing the construction of the Venturi meter tube and the material used.

"Metal Lath Hand-Book," published by the Associated Metal Lath Manufacturers, Youngstown, Ohio, contains a large amount of data on metal lath and its uses. It is designed to place concisely before architects and contractors the best methods of using metal lath. The price of the book is $1.

The Detroit Graphite Co., Detroit, Mich., has issued a bulletin on complete maintenance painting specifications for manufacturing plants, storage buildings and power houses which are in operation, and ought to be of value to superintendents, engineers and others in charge of building maintenance.

The Edwards Manufacturing Co., Cincinnati, Ohio, has isued a four-page folder describing how Edwards rolling doors of galvanized iron saved a quantity of material and cars during a fire at a pier in Philadelphia of the Baltimore & Ohio Railroad.

The Waldo Hardness Tester, for testing the hardness of metals under conditions of service, is described in a pamphlet recently issued by the Palo Co., 90 Maiden Lane, New York City.

The Municipal Supply Co., of Chicago, has issued a folder describing the Directograph recording meter, claimed to be the only meter that records the flow of water with a continuous and permanent ink line, thus giving a complete and immediately available record of velocity, quantity, pressure and output. The company is also featuring, in its literature, a new type of tapping connection which, it is said, the City of Chicago has used for more than seven years to cut the cost of tapping water mains.

The National Lime Manufacturers' Association has published in the form of bulletins addresses by Miss Frances Kellor on "The Americanization of Workmen Around the Lime Plants" and by H. J. Russell on "The Necessity for Lime Manufacturers to Stop Cutting Prices and Get More for Lime."